[COMMITTEE PRINT]

SUBJECTS AND POLICY AREAS FOR THE CONSIDERATION OF THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

99TH CONGRESS

REPORT

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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
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Washington, DC 20515.

To the Members of the Committee on Science and Technology:

The Legislative Reorganization Act of 1970 charged the Congressional Research Service of the Library of Congress with providing Congressional Committees, at the beginning of each Congress, a "list of subjects and policy areas the committee might profitably analyze in depth." I am transmitting herewith the report "Subjects and Policy Areas for the Consideration of the House Committee on Science and Technology, 99th Congress."

This report is the eighth of its kind prepared for the committee, and is in part based on extensive interviews conducted by the CRS with the committee staff as well as further staff discussions as the material was developed.

I believe the committee will find this report a useful resource as it proceeds with its legislative and oversight activities during the 99th Congress. The report identifies a number of emerging issues which are likely to command attention as the committee emphasizes its oversight and legislative responsibilities.

Sincerely,

DON FUQUA, *Chairman.*

Congressional Research Service
The Library of Congress

Washington, D.C. 20540

LETTER OF SUBMITTAL

March 13, 1985

Honorable Don Fuqua
Chairman, Committee on Science and Technology
House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

As you know, the Legislative Reorganization Act of 1970 requires the Congressional Research Service to make available to each committee, at the beginning of each Congress, "a list of subjects and policy areas the Committee might profitably analyze in depth."

The report on the Act declared that the list is intended to assist committees and the Service in planning their respective research schedules for the forthcoming Congress, and it instructed the Service "to work closely with committee staffs in the preparation of that list."

As a result of discussions between William Boesman of CRS and Dr. Harold P. Hanson of the Committee staff, a list of subjects suggested for analysis is transmitted herewith, which we hope will be valuable to the Committee and reflect its interests during the 99th Congress.

It is understood, of course, that the inclusion of any particular subject on your list does not represent a judgment on the part of CRS that your Committee has either prior or exclusive jurisdiction over that subject.

As instructed by the Joint Committee on the Library, CRS regards this list as the property of your Committee; unless wider distribution is authorized, it is available only to Members of the Committee, upon their request. We anticipate that we will receive requests for copies of the enclosed list from Members who do not sit on your Committee and from congressional support agencies. It would be helpful, therefore, to know how you would like us to respond to such requests. We would appreciate receiving your instructions by letter or by return of the enclosed copy of this letter with your instructions noted in the designated space. Please send your instructions to Elizabeth Yadlosky, Associate Director, Research, Analysis, and Multidisciplinary Programs.

It is my sincere hope that this list will be useful to the Committee. So far as our resources permit, we will be happy to respond to any requests for initial or further analysis of subjects on the list, or other subjects as they arise, or for any other suitable assistance.

Sincerely,

Gilbert Gude
Director

Enclosure

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Washington, D.C. 20540

REPORT FOR THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY ON THE SUBJECTS AND POLICY AREAS WHICH THE COMMITTEE MIGHT WISH TO ANALYZE IN DEPTH DURING THE 99th CONGRESS

Submitted in Accordance with Section 321(a)
Legislative Reorganization Act of 1970

Prepared by the
Congressional Research Service
Library of Congress
March 4, 1985

ACKNOWLEDGMENTS

This compilation of Subjects and Policy Areas for the House Committee on Science and Technology for the 99th Congress was coordinated by William Boesman of the Science Policy Research Division. Divisional review of the final product was provided by Dr. Gail Marcus. A number of CRS analysts and specialists contributed their efforts to suggesting and developing appropriate entries for this report; these persons are listed below and their efforts are gratefully acknowledged.

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1. GENERAL FEDERAL SCIENCE AND TECHNOLOGY POLICY

FEDERAL SCIENCE AND TECHNOLOGY CONSOLIDATION

Issue

What are the current proposals for consolidation of Federal science and technology support? What are the pros and cons of these proposals?

Background

Several committees have heard testimony recently about creating a National Technology Foundation, or variant, to support directly applied research and technology development to enhance American industrial capacity for technological innovation and international high-technology competition. Alternatively, the Committee on Research and Development of the President's Council on Industrial Competitiveness, in January 1985, recommended creation of a Cabinet-level Department of Science and Technology, reviving a proposal often made. The plan would combine the science and technology functions of all agencies except the regulatory commissions and the Departments of Agriculture and Defense.

Proponents argue that consolidation ultimately would strengthen the knowledge base, productivity, and competitiveness of U.S. industry. This is compelling, considering the more coordinated organizational arrangements for determining national priorities and for funding science and technology in Japan, the Nation's major high-technology competitor.

Supporters cite such advantages of the proposal as coordination of all Federal policies for research, regulation, national security, and trade relating to science and technology; realization of cost savings from combining programs for basic and applied research, technology development, and use of research facilities; and development of comprehensive science education and manpower policies.

Opponents argue that science and technology should be supported directly, that the superior achievements of U.S. science flow from pluralism in funding and governance, and that agencies should support science and technology related specifically to their missions. Other criticisms are that 70 percent of federally-funded research would be excluded; significant costs would be incurred in realigning agency functions; the reorganization would emphasize technology and "big science" and drive out basic research, "little science," and investigator-initated projects; and it would be difficult to reconcile congressional committee jurisdictions for agencies that have handled science and technology and costly politically to remove multiple influence points for science and technology.

Analysis

The Committee may wish to consider the costs and benefits of consolidation in terms of research output, strengthening the competitive position of U.S. industry, and political feasibility; the appropriateness of the objectives sought; and whether consolidation will achieve them. Specific legislation would have to be enacted also, for instance, to abolish the Office of Science and Technology Policy and to reorganize the National Science Foundation, the National Aeronautics and Space Administration, and the Departments of Commerce, Energy, Health and Human Services, and the Interior. Direct Federal support of technological innovation through the congressionally proposed technology foundation may be considered a feasible alternative to consolidation.

INCREASING FEDERAL FUNDING OF DEFENSE R&D

Issue

The Committee may want to examine recent trends reflecting increased Federal funding for defense R&D, decreased Federal funding for civilian R&D, and the implications of these patterns for universities, faculty retention rates, composition of student bodies, manpower supply, differential rates of development of the sciences, progress in accumulating basic scientific knowledge, and international industrial competitiveness.

Background

Federal funding for military R&D is estimated to constitute 69 percent of the FY85 R&D budget. Military R&D support increased almost 70 percent in constant 1972 dollars over the period FY 1981 to 1985, about 3.5 times the increase for NSF, which was 20 percent. Federal support for civilian research overall decreased 14 percent since FY81. Comparative international statistics show that, although the United States spends more on R&D than all of its major economic competitors combined, it spends less as a proportion of GNP than any of these countries when military research expenditures are subtracted. Some critics say this trend explains why the United States lags behind Japan, for instance, in developing high-technology markets in foreign countries. The argument is also made that cutbacks in civilian R&D funding and increases in defense R&D funding will erode the state of U.S. science and technology because researchers will be lured to work on defense research by higher salaries and more challenge. As a result, some allege that the development of U.S. industrial technology will suffer and that there will be lags in the accumulation of new knowledge in scientific disciplines of little interest to the military sector. Because it focuses on weapons development, some charge that defense R&D may not generate knowledge transferable to the civilian sector or knowledge breakthroughs useful in the long term. Some observers note that increased defense funding perpetuates inequalities in geographic distribution of funding for R&D. However, others argue that these deficiencies are more than offset by the profitable spin-off technologies generated by military R&D funding, technologies, which, for instance, nurtured the U.S. aerospace, semiconductor, and computer industries. They also hold that current defense R&D funding is justified by the requirements of national security and that the funds used for defense-related R&D probably would not be spent for civilian R&D in any case.

Analysis

The Senate Armed Services Committee in 1984 asked the Defense Department to evaluate the capabilities of universities to respond to increased defense research needs and to absorb increased funding. The Science and Technology Committee may want to examine the proposed report. In addition, it may be appropriate to examine the evolution of several new initiatives. For instance, the Department of Defense has stepped up its programs to support improvements in university instrumentation and manpower training and the DOD-University Forum has attempted to reconcile some of these issues. Still remaining unresolved are issues of prepublication controls on the release of research information compiled by university researchers funded by DOD and assessment of the differential impacts of defense R&D spending on U.S. industrial and economic competitiveness.

NATIONAL SCIENCE FOUNDATION PROGRAMS

Issue

Will greater emphasis and funding within NSF in such areas as biotechnology and engineering dilute the fundamental mission for which the Foundation was created--to support basic research in all the sciences?

Background

Since 1950, when NSF was founded, it has primarily concentrated its efforts in funding basic research. Beginning in the early 1970s, the Foundation began to receive pressure from Congress and certain groups in the scientific community to increase funding for engineering research. Concerns regarding support for engineering research were reduced when NSF established a separate directorate for engineering in 1980. However, recent events have raised concerns in the scientific community that NSF may devote more of its resources to engineering and biotechnology. First, a congressionally-approved amendment to NSF's organic act would have placed greater emphasis on engineering in the Foundation's programs. That amendment was pocket vetoed by the President on October 30, 1984. The second event was the recent appointment of Eric Bloch, from IBM Corporation, the first manager-engineer to serve as the director of the Foundation. Mr. Bloch has indicated that biotechnology and engineering should receive greater emphasis within the Foundation. Further, from 1980 to 1985, support for engineering research within NSF rose from $76.6 million to $147.1 million, the largest percentage increase for any directorate.

Analysis

In the past, NSF has always avoided supporting research that would lead to the development of particular products or processes, because such work was seen as the responsibility of industry. However, with NSF's funding of cross-disciplinary research centers in engineering, many in the scientific community contend that NSF is now being asked to play a key role in the revitalization of America's lagging industrial capabilities. The issue is whether such a change in emphasis will erode NSF's support for basic research.

Some scientists have pointed out that support for engineering research by DOD, DOE, and NASA far exceeds NSF. They claim that these agencies should take the lead in attempting to overcome the Nation's engineering shortcomings. However, other scientists contend that the mission-oriented agencies are limited by law to spending their money on narrowly defined applied problems. They believe that it is appropriate for NSF to support research on engineering "methodologies" or "generic technology."

Another issue for congressional concern is whether or not NSF is the appropriate place to pursue research in the area of industrial applications. There are those who contend that perhaps a new Federal entity to manage research programs directed toward the development of new technologies would be more appropriate.

R&D FUNDING SUPPORT MECHANISMS

Issue

The Committee may want to review alternatives to traditional investigator-initiated university research funding, which have been suggested as ways to cope with cuts in Federal funding for civilian research, complaints about the time and effort required to prepare proposals and comply with Federal accountability reporting requirements, alleged biases in the peer review system, and lack of utility in research output.

Background

The traditional mechanism used to support basic research conducted in universities--the individual investigator-initiated award--seems to have served the Federal Government well for the last 40 years in terms of research productivity, publication rates, and prizes. However, the environment in which research is supported has altered considerably, perhaps enough to justify development of alternative funding mechanisms. For instance, although the Government is still the largest supporter of university research, the Federal proportion has decreased as a percentage of total support as industry's share increased. As a result, perhaps, researchers have less time to write proposals for Federal support, which may never get funded, or to conduct peer reviews for the Government. It has been estimated that it "costs" 2.5 full-time-equivalent person-years to obtain and manage $1 million worth of federally-funded university research--a figure some critics consider excessive. Researchers have increasingly begun to criticize the time and effort needed to comply with Federal accountability forms. In addition, some critics say that the traditional Government-scientist funding relationship needs to be altered to lower expectations of funding for nondirected basic research.

Analysis

The efficiency and effectiveness of alternatives to the traditional project grant system for funding university research should be evaluated with respect to research quality and productivity. It may be useful to examine the premise that Federal research investments should be geographically distributed, and to concentrate funding in only a few high-quality universities. Other proposals include the following: the award of a "pot" of funds to one proven, highly productive researcher, who would distribute some of the funds to other researchers or the award of long-term or block funding to proven research-productive universities; the funding of individual researchers solely on the basis of demonstrated productivity, not on the basis of a new proposal; the utilization of a "productivity-review system," as proposed by Rustum Roy, of Pennsylvania State University, which would award funds according to a formula which would take account of a research unit's production of graduate students, number of papers published, and amount of support received from other sources; the development of additional incentives for university-industry partnerships and cost-sharing and the exploration of the master grant concept; and the mandate that industry ask university researchers to conduct some proportion of research funded with independent R&D funds awarded by Government, or the development of a "superfund" for research at universities, supported by the profits of research-intensive industry.

FEDERAL LABORATORY MANAGEMENT AND MISSIONS

Issue

Would oversight of the management and missions of the Federal laboratories, and of the implementation of the report of the Federal Laboratory Review Panel of the White House Science Council (the "Packard Report") be timely?

Background

The Federal Government has over 700 R&D laboratories, ranging from very small field stations employing a handful of people, to very large facilities with budgets in the hundreds of millions of dollars. For 1984, it is estimated that Federal expenditures through the laboratories totaled about $15.6 billion, or about one-sixth of the Nation's R&D spending.

In May 1983, the White House Science Council issued a report on actions to improve the use and performance of the laboratories in response to a request from the President's Science Advisor, Dr. George A. Keyworth. Its Panel made 12 recommendations in five areas: laboratory missions, personnel, funding, management, and interactions with universities, industry, and the users of research results. The report is quite brief, containing no data to support its findings and recommendations.

Subsequently, the President received the report, directed that its recommendations be implemented, and asked that a study be done of their implementation. The study has not been released.

Analysis

The Federal R&D laboratories are typically viewed as a very large and important national resource, whose management is a perennial problem. Typically, laboratories are established in response to a national need and, if and when the need has been met, they are assigned new missions, terminated, or allowed to become a problem. Because they have local and regional constituencies concerned with employment and spin-offs to the area, as well as national constituencies concerned with the original missions, they are difficult to terminate. Furthermore, arguments can be made that rather than termination, the human, managerial, and capital resources they embody should be redirected to meet the new needs of the Nation as they emerge. To assist in their management and reorientation, some have suggested putting all of the laboratories under a central coordinating body, or making them the core of a new Department of Science and Technology.

The forthcoming report on the implementation of the Packard report will set an agenda for further consideration of the missions and management of the Federal laboratories. In view of the initial report's brevity and lack of data, and of the complexity of the Federal laboratory system, it may be useful to carry out a more wide-ranging inquiry into the problems and potential of the laboratories. Since many of the laboratories have missions tied to particular agencies, the category, "national laboratories", may prove to be too broad to serve as a basis for policymaking. If so, separate attention may be required for each of the missions, while more generic consideration might be given to some of the cross-cutting issues of personnel, funding stability, and interaction with external science and technology interests.

"GRACE COMMISSION" R&D REPORT

Issue

Does the "Grace Commission" R&D report accurately reflect savings which feasibly could be made in the Government's R&D budget?

Background

On June 30, 1982, President Reagan established the President's Private Sector Survey on Cost Control (PPSSCC) in the Federal Government, which has issued a series of 47 task force and special reports on a number of subjects, including a Task Force Report on Research and Development. The entire series of reports is called the "Grace" report after J. Peter Grace, chairman of the executive committee established to carry out the study. The President directed the PPSSCC to consider providing recommendations in the following areas: opportunities for increased efficiency and reduced costs in the Federal Government that can be realized by executive action or legislation; areas where managerial accountability can be enhanced and administrative control can be improved; opportunities for managerial improvements over both the short- and long-term; specific areas where further study can be justified by potential savings; and information and data relating to governmental expenditures, indebtedness, and personnel mangagement.

The R&D task force report itself makes 25 recommendations in the following seven major issue areas: strategic planning; R&D management and the budget process; privatization; improved management of resources in Federal research laboratories; administration of research grants to universities; research program reporting; and NASA cost reporting. These seven major issue areas were selected for study by the R&D task force because they represent the largest potential cost savings of all issues surfaced; they require the highest level support to obtain resolution, and they are fundamental or underlying causes of many problems identified, but not resolved, by past studies. On November 7, 1983, the Senate Committee on the Budget held a hearing on the "Grace" report. The two witnesses were J. Peter Grace, Chairman of the PPSSCC, and Rudolph G. Penner, director of the Congressional Budget Office. In 1984, a CRS report and a joint Congressional Budget Office-General Accounting Office analysis of the major proposals of the "Grace" report were published. Another GAO analysis is due in early 1985.

Analysis

Many of the R&D task force's substantive findings and recommendations parallel current views, findings, and activities in both the legislative branch and the executive branch, although quite a few also are likely to find opponents as well as proponents in the Congress and among the Federal R&D agencies. The R&D task force report's proposals in the area of "R&D management and budget process," for example, are likely to be controversial because they probably would require significant changes in congressional authorization, appropriation, budget, and other processes related to R&D policies and programs. Also, many of the R&D task force report's estimates of cost savings are questionable, both in methodology and magnitude. It appears that the estimated savings attributable to the first seven R&D issues, which are dealt with explicitly in the R&D task force report, would be about 8.1 percent of the total Federal R&D budget in the first year. If to this were added the savings estimated as being attributable to selected R&D issues found in 14 other task force reports, it appears that the total estimated savings would be about 24.6 percent of the total R&D budget in the first year. This latter figure, however, may include instances of double counting of dollar opportunities among the 14 other task force reports considered. The extent of this possible double counting is not made clear in the R&D task force report.

There is, thus, some doubt as to the accuracy of the dollar estimates of many individual, and the total, cost savings attributable to recommendations in the area of research and development found in the R&D task force report, although it is likely that significant savings are possible, particularly in the areas of procurement, acquisition, and budgetary planning and management related to research and development.

RESEARCH AND PROBLEM ASSESSMENT IN THE REGULATORY AGENCIES

Issue

What are the potential contributions to efficient and effective environmental, health, and safety regulation of strengthening support for basic research and for problem assessment in the regulatory agencies, including the potential of a new central body to support this kind of research, modeled perhaps on the National Institute of Occupational Safety and Health (NIOSH)? What are the potential costs?

Background

It is widely recognized and accepted that the Federal regulatory agencies need to do R&D related to the diagnosis and solution of environmental, health, and safety problems so that they can knowledgably promulgate effective regulations. With the broader use of risk assessment and other formal tools in regulatory decisionmaking, the results of such research have taken on new importance to policymakers.

However, despite its emphasis on the importance of "good science" as a basis for regulation, and despite its professed preference for Government support of basic research, the Administration has asked for reduced regulatory agency R&D budgets. For example, the R&D budget of the Environmental Protection Agency, which stood at $345 million in FY80, fell to $234 million in FY83, before being increased to $305 million in the FY85 budget (current dollars). Furthermore, within the regulatory agencies, there is a continuing tension between focusing R&D on the current regulatory agenda and focusing it on longer-term studies to facilitate early identification and amelioration of emerging problems, as well as to find more far-reaching solutions to such problems.

Thus, maintaining a strong R&D capability in each regulatory agency remains important. However, in view of the pressures on their budgets, especially on basic research; of the increased degree to which the same hazards are the concern of multiple agencies; and of the recurring threat of compromise for political ends of the quality of the research performed by the mission agencies, it may be useful to consider alternative arrangements. Perhaps a central organization could perform and support some research, especially basic research and problem assessment, for all of the agencies. A useful model might be NIOSH, part of the Center for Disease Control of the Department of Health and Human Services, which does research on occupational health problems that may be brought to the attention of the regulatory agency, the Occupational Safety and Health Administration (OSHA), which is part of the Department of Labor.

Analysis

The Committee may wish to examine, systematically and across agencies, the effectiveness of existing programs of research and problem assessment in the regulatory agencies in order to determine whether changes in the programs, priorities, or budgets of individual agencies, or the assignment of such responsibilities to some other agency, such as the National Institute of Environmental Health Sciences or a new agency, might improve the effectiveness of regulatory science and problem assessment.

EFFECT OF REGULATIONS AND JUDICIAL DECISIONS ON SCIENCE AND TECHNOLOGY

Issue

The freedom of scientific inquiry is being circumscribed, in some cases, by single-issue advocates often indifferent to the beneficial impacts of scientific progress and its prerequisites. Some of these issues are being adjudicated administratively or in courts of law, others are being defined and debated by scientists themselves or by more broadly representative interagency groups. There are major inconsistencies in the kinds of restrictions placed on private or publicly funded research.

Background

Restraints on the conduct and application of science are impelled by values in conflict with certain scientific pursuits. Examples of restraints on the generation of knowledge consist of limits on human experimentation and survey research, flowing from concerns about invasion of privacy; opposition to human fetal research and to the use of stray or laboratory-bred animals for ethical reasons; and environmental controls on the release of genetically-altered frost-prevention plant material and use of human growth genes in animals, due to environmental fears, rejection of altered genetic strains, and fears of the unknown. Controls on the application of knowledge are also manifested by existing and proposed prepublication review and export control regulations governing the free flow of nonclassified scientific and technical information.

Some kinds of regulations and judicial decisions result in costly halts to research in progress, as well as the loss of major economic and social benefits. All facets of the public interest might be better served if there were more informed and balanced public debate about these actions and legislative action to guide the development of consistent regulatory policies in the public interest. Congressional policy has not been clearly enunciated in most of these areas, but the opportunity for legislative policymaking is propitious. For instance, federally-funded research on altered genes and use of animals is being regulated, but equivalent privately-funded research is allowed to continue unregulated. Many believe that genetically altered animal and plant strains could help alleviate hunger. A temporary injunction halted the release of basic genetically altered plant organisms. The work of the recently established Interagency Working Group on Biotechnology, under the Cabinet Council on Natural Resources and the Environment, may be influential in the final court decision. The costs to scientific progress from control of information flows might outweigh the benefits of release. In some cases, national security and executive privilege are the principal policy determinants. The President is to issue his national policy statement on scientific and technical information early in 1985. This will guide policies to apply export controls to sensitive and nonsensitive research conducted at universities. In some cases the responsibility for policy determination about the ethical aspects of research has been given to institutional review boards. This remedy may not suffice in the future as debates about complex scientific issues need to consider broader issues of "the public good."

Analysis

It may be appropriate for the Committee to inventory and assess the impacts of the various constraints on scientific research and to enunciate legislative statements defining acceptable policies in these areas--areas which, without the benefit of legislative policy determination, are having policies established in some cases in the courts, by administrative judges, scientists themselves, or specific issue advocates. Alternatively, the Committee may wish to consider administrative mechanisms to permit balanced, informed debates about restraints on scientific inquiry. The Committee might also want to consider the development of guidelines for control and sanctions for noncompliance, rather than leaving these matters to the courts.

SCIENCE AND TECHNOLOGY IN FEDERAL EMERGENCY MANAGEMENT

Issue

Examination of emergency management in the Federal Government, especially the technical skills and competencies of the Federal Emergency Management Agency.

Background

The Federal Emergency Management Agency (FEMA) is charged with preparing for, and responding to, peacetime emergencies that are caused by nature or are manmade, as well as to wartime emergencies. These include such events as earthquakes, hurricanes, floods, major industrial accidents affecting the public, as well as wartime problems.

During the last two sessions of Congress, the House Science and Technology Subcommittee on Oversight and Investigations has held a series of hearings and workshops on information technology for emergency management in which FEMA has played a central role. The outcomes of the various activities included a set of recommendations for action by FEMA, other Federal agencies, State and local authorities, and Congress. Among these were a number that would have the effect of enhancing the technical capability of FEMA and other agencies to manage information in anticipating and responding to emergencies.

A number of recent developments suggest that FEMA's technical expertise might benefit from a stronger program of research, development, and technology evaluation. For example, the Bhopal chemical disaster in India and the subsequent attention to industrial management of hazardous circumstances in the U.S. points up a possible need for improved systems of detection, warning, and response to industrial disasters. Also, there are now indications that some level of earthquake prediction will be possible in the near future, and managing this capability adequately will further challenge FEMA. Finally, questions have been raised in other fora about the depth of technical competence in FEMA and allegations have been raised that the agency makes insufficient use of the scientific and technical expertise available to it from other Federal agencies, as well as nongovernmental sources.

Analysis

Some of the uncertainties about the technical capabilities of the agencies arise from the vast array of potential problems to which FEMA is expected to be able to respond. On the other hand, it may be useful for the Committee to widen its previous inquiries into FEMA and its operations to examine the broader questions of how FEMA accesses scientific and technical information in general, the technical competence and breadth of the FEMA staff in view of the breadth of its mandate, and whether and how FEMA might initiate support of internal and external research and technology development and assessment programs that would enhance its internal technical capability and at the same time serve to enhance the availability of technology related to emergency management. Consideration might be given to statutory establishment of such activities, along with a formal mechanism for ensuring continued input of scientific and technical advice from other agencies and the external community.

THE FUTURE OF U.S. SCIENCE

Issue

The era of U.S. global dominance in science and technology may be ending. Growing competence in all areas of science by foreign nations and the rising cost of large-scale scientific projects, or "megaprojects," may mean that the United States cannot expect or afford to be preeminent in all scientific fields. How will the diminished U.S. worldwide scientific leadership affect the development of science policy in the United States? Should the United States engage in more cooperative international research ventures?

Background

Limitations of funding for U.S. science and technology coupled with the expansion of scientific investment by Western Europe, Japan, and the Soviet Union have contributed to the decline of U.S. dominance in world science. Further, with more R&D resources aimed at improving industrial innovation, along with expected future budgetary constraints, the United States may have to be more selective in deciding which areas of research it will support fully. Presidential science advisor George Keyworth has stated that the United States cannot expect to be preeminent in all fields of science. Consequently, the Reagan Administration has been talking in terms of pursuing some areas of "macroscience" through an "international division of labor."

The Administration and many scientists contend that there are a number of areas for U.S. involvement in international scientific megaprojects, such as fusion research, high-energy physics, and space research. These projects would increase the diversity of scientific talents that would not normally be available, and reduce the financial burden and risk for the different nations involved. However, others in the scientific community have indicated that there are a number of barriers that must be overcome in order to increase U.S. participation in global science projects. These barriers include the strong parochial nature of U.S. science, decisionmaking procedures within each country, and legal, national security, and proprietary concerns.

Analysis

If the Administration pursues a policy of more international participation by the United States in macroscience projects, then the United States probably would have to relinquish its national advantage in certain scientific fields. Congress may want to influence how such decisions are made and their likely impact on science and the Nation.

Another area of concern is the annual appropriations process which often makes commitments to multiyear projects difficult. Consequently, Congress is often confronted with the dilemma of reneging on international commitments or cutting domestic science projects in order to meet prior international commitments. If the United States wants to be considered a reliable research partner, Congress may have to investigate the potential costs and benefits of multi-year funding for certain international science activities.

Congress also may want to examine how the Administration's focus on national military security may affect progress towards more international scientific cooperation.

2. AERONAUTICAL AND SURFACE TRANSPORTATION R&D

AIR TRAFFIC CONTROL SYSTEM

Issue

Increased air traffic, deregulation, and fewer air traffic controllers possibly are contributing to an increased burden on the air traffic control system. It is possible that new technology, such as collision avoidance and advanced landing systems, can increase system capacity while still ensuring safety.

Background

The Federal Government has stopped regulating airline schedules and routes, thus allowing airlines to schedule flights based on market demand, which has resulted in crowding at some airports. Levels of air traffic have grown steadily and are now equal to, or greater than, before the 1981 air traffic controller strike. However, there are fewer air traffic controllers now and fewer of them are fully qualified. The Federal Aviation Administration (FAA) does not plan to return to the pre-strike level of controllers, in part because the introduction of new technology is expected to reduce the number of required personnel and increase system capacity. In the meantime, some controllers have complained of forced overtime, loss of vacation and sick leave, and increased stress.

The National Airspace System Plan, a 20-year plan begun in 1982, will modernize the existing air traffic control system. One major component of the plan is the introduction of new, high-speed computers which will handle higher levels of air traffic. Microwave landing systems, to be put in airports across the country, are expected to increase air traffic capacity, allowing more aircraft to land. Area navigation and short-takeoff and landing technology also are expected to relieve airport congestion.

Analysis

Although airline passengers and the airlines were irritated by delays, particularly during the summer of 1984, safety is the overriding concern in air travel. Some observers believe that delays are only one symptom of an overburdened air traffic control system, but the FAA has said that there has not been an increased danger of mid-air collision. According to the FAA, the increased number of air traffic control errors which have been reported is the result of a new computerized system which is more sensitive to errors. Furthermore, only a very small percentage of those errors reported were serious. In addition, the FAA is developing a system to avoid mid-air collisions, called TCAS (Traffic Alert and Collision Avoidance System). TCAS uses a small device that can be carried on the aircraft and operated independently of the air traffic control system. As with the National Airspace System Plan, prompt implementation of TCAS technology is urged to meet rising demands on the air traffic control system while maintaining safety.

AVIATION SAFETY R&D

Issue

The Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA) are continuing aviation safety R&D on fire safety, weather, crashworthiness, and other areas. The question is whether the FAA is proceeding as quickly as possible to implement this R&D in commercial aviation.

Background

Commercial air transportation is one of the safest ways to travel today, which would indicate to some that the FAA, the airlines, and Congress are doing a good job of keeping commercial aviation safe. As long as aviation accidents occur, however, there is a need for technology which can improve safety. The FAA is currently researching aviation safety in several areas which may increase survivability after a plane crash, thus saving passenger lives. A new rule, adopted in October 1984, requires that commercial airlines gradually introduce a fire blocking layer in seat cushions, and other research is proceeding on fire resistant walls, ceiling panels, and windows. In addition, the FAA has been testing an anti-misting kerosene (AMK) safety fuel to reduce post-crash fires. In December 1984, the FAA conducted a controlled impact of a large-scale aircraft to test AMK as well as to test the crashworthiness of the aircraft frame and interior. Despite the fact that the controlled impact test ended with the aircraft gutted by fire, the FAA has said that AMK did effectively prevent fuel misting and a "primary" fire. Others argue that the test was a failure. The ultimate question is whether the FAA will proceed with a notice of proposed rulemaking, the next step before requiring the use of AMK by commercial airlines. The controlled impact test also measured the crashworthiness of the aircraft frame and interior, and reportedly, enough data survived the fire to be useful for further studies. The FAA is also developing an advanced system for detecting windshear at airports, where aircraft are vulnerable to sudden changes in wind direction during takeoff and landing.

Analysis

The FAA's primary tool for increasing aviation safety is regulation. Its regulatory responsibilities range from aircraft design to airport configuration and inflight operating procedure. According to some observers, the FAA has lagged in implementing advances in aviation technology. Some have argued that, because the FAA must both promote the aviation industry and regulate safety, the FAA has moved too slowly. For example, the National Transportation Safety Board has called for stronger aircraft seats, which could protect passengers during a crash, but the FAA maintains that more research is required. The FAA had planned to move closer to new regulations for seat strength and AMK following the 1984 controlled impact test, and it remains to be seen whether more studies are required following those results.

HIGHWAY RESEARCH AND DEVELOPMENT

Issue

The National Research Council recently published a report which concluded that money spent on maintenance alone will not arrest the spreading deterioration of America's highways; more research is needed. A major reason for lack of highway research programs and funding is "extreme fragmentation" of Federal, State, and local authority.

Background

A significant portion of the roadways and bridges of the Nation is now, or soon will be, in a serious state of disrepair. The Department of Transportation estimates that nearly ten percent (4,000 miles) of the Interstate Highway System is in immediate need of resurfacing or replacement and approximately 50 percent of the Federal-aid primary highway system (other than Interstates) will have exceeded its design life by 1990. Furthermore, 23 percent of the Nation's approximately 574,000 bridges are currently classified as "structurally deficient".

The situation is worsening because maintenance have not kept pace with the rate of deterioration. There appears to be a majority opinion that innovation is necessary; however, research for improved highways has been seriously neglected in recent years. Spending on highway research relative to total highway expenditures has fallen from 0.25 percent in 1965 to 0.15 percent in 1982. This is lower by about a factor of eight than R&D expenditures for comparable low-technology industries.

Currently, the U.S. highway system's operation is divided among thousands of Federal, State, county, city, and private organizations. There is no integrated long-range plan and little incentive for innovation.

In May 1984, a joint report of the Subcommittee on Investigations and Oversight and the Subcommittee on Transportation, Aviation, and Materials of the House Committee on Science and Technology, entitled Highway Transportation Infrastructure Research and Technology, was published. The report covered three days of joint hearings on the subject held in June 1983.

Analysis

The National Research Council recommends a concerted research effort administered at the Federal level utilizing 0.25 percent of current Federal highway aid. This program may be critical for maintaining the useability of the Nation's expensive and aging highway network. Careful oversight of this issue may be useful in assuring that a program such as this is expeditious and properly directed in the national interest in order to protect the Nation's transportation infrastructure from further deterioration.

LAND TRANSPORTATION SAFETY R&D

Issue

Transportation-related accidents account for over 50,000 deaths per year and cost billions of dollars in property damage, medical care, and lost work time. Most of this toll is from motor vehicle accidents, but railroad accidents also have caused concern in recent months. Automotive and railroad safety R&D would be a useful subject for study to determine what technologies are available, or could be made available, to reduce the accident toll.

Background

According to the National Safety Council, motor vehicle accidents during 1983 accounted for 44,600 deaths, 1,600,000 disabling injuries, and $43.3 billion in overall cost to society (including lost wages, medical expenses, and property damage). Railroad accidents in that same year caused 1,073 deaths and 34,819 injuries. Some of this toll could be alleviated by technologies now in existence or under development. For example, anti-skid braking systems now being introduced promise to increase safety by preventing loss of control of the automobile on wet or slippery surfaces. Other such improvements might include "friendly" automotive interior design, computer analysis of automotive maintenance problems, and anti-drunk driving devices intended to prevent motorists from being able to use their cars while inebriated.

With regard to railroads, a series of accidents during 1984 raised concerns as to the safety of the rail system. Rail safety problems include inadequate maintenance of tracks and equipment, rail-highway crossing problems, and alcoholism among employees. Some of these concerns might also be alleviated by technological improvements.

Analysis

The Reagan Administration is following a policy of diminished Federal regulation of the auto industry, as compared with previous administrations. Thus the passive restraint requirement has been delayed, the bumper standard has been lowered, and so on. This policy does not prevent the automobile industry from taking steps on its own to increase automobile safety. Technologies that would improve automotive safety at minimal cost could be of great interest, both to the automotive industry and to the Government.

With regard to rail safety, there similarly would be an interest in technological means of decreasing the frequency and severity of rail accidents.

MARINE SURFACE TRANSPORTATION R&D

Issue

The U.S. maritime transportation industry is a valuable national asset. Almost one billion tons of the Nation's imports and exports are transported annually by this industry. Approximately one billion tons of cargo are transported annually by the domestic waterway operations element of this industry, of which about 60 percent is transported by the inland waterway sector. In the interests of achieving a competitive, vibrant seafaring industry based in the United States, a continuing national program of marine transportation R&D bears examination.

Background

An estimated 70 to 75 percent of the world's foreign trade and commerce is carried in ships and other watercraft on the ocean, seas, and waterways of the world. The conduct of a vigorous marine transportation R&D effort bears consideration if the United States is to regain a competitive posture on the world ocean. It is necessary from time to time to reexamine and review the vitality, purpose, adequacy, and direction of the existing U.S. marine transportation R&D effort in order to identify and attempt to remedy possible current and furture deficiencies, gaps, and specific problems. It is also useful, on another level, to consider whether the technology and facilities where such research is conducted are adequate and whether new technology is being integrated into present marine transportation research programs.

Analysis

Several areas and fields of marine R&D are currently being pursued federally and privately in the maritime industry. Coping with high cost and declining quality of marine fuels has become a problem, imposing ever-increasing operational costs on ship owners and operators for pretreatment and cleaning of heavier, lower grade bunker fuels, to cite just one example. This in turn implies a need for study of alternative fuels for maritime use and of marine power/propulsion systems and engine options for the 1980s (including commercial sail). In these days of rising fuel costs, making shipboard electrical generation systems more efficient, economizing on electrical demands, and finding new, fuel-efficient ways of producing electricity beyond the conventional diesel generators could prove beneficial in the long term. In order to make better and more efficient use of marine fuels of whatever kind, the search for more economy in maneuvering and thrusting might be accelerated to catalyze research into power-conserving propellers and thrusters.

Training and crewing for the electronic age in shipping and gauging the impact of electronics on shipping operations are emerging as issues unequaled in importance. Minimizing the time a ship is out of service for inspection, maintenance, repair, and overhaul can be crucial to economic operations. Consequently, it appears appropriate to encourage continued investigation and research into marine coatings and finishes as well as other methods of countering or controlling biofouling and corrosion of marine surfaces and materials. Faster turn-around in shipyeards implies the need for continuous review and reexamination of present methods of construction and conversion involving a greater degree of reliance on prefabrication and subassemblies.

Other issues bearing investigation are the extent to which new technology is being developed by other maritime nations, the adequacy of such technology, and the degree to which this technology is penetrating the marketplace. It is also useful to consider the balance between federally-funded programs and privately-supported efforts in view of the Administration's policy to reduce Federal spending and bureaucracy, to rely more heavily on free market forces and private sector investments for near-term technological development, and to emphasize Federal funding priorities for long-term, high-risk research and development.

3. AGRICULTURAL RESEARCH

See also items:

10.5 THE INTERNATIONAL AGRICULTURAL RESEARCH SYSTEM

10.6 ENVIRONMENTAL EFFECTS OF INTERNATIONAL AGRICULTURAL DEVELOPMENT PROJECTS

See also section:

8. FOOD AND NUTRITION RESEARCH

PRIORITIES FOR AGRICULTURAL AND FOOD RESEARCH

Issue

The Joint Council on Food and Agricultural Sciences' FY85 annual report, Priorities for Research, Extension and Higher Education, selected and ranked a number of major priorities for the food and agricultural sciences system. Five of the eight highest priority areas received no special emphasis in the FY85 budget. Needed may be an examination of the implications of governmental and industrial priorities and patterns of the food and agricultural sciences system and the extent to which the agricultural science community is directing resources into priority areas.

Background

Section 1407(d)(2)(G) of Title XIV of P.L. 97-98, the National Agricultural Research, Extension, and Teaching Policy Act Amendments of 1981, requires that the Joint Council on Food and Agricultural Sciences develop annual priorities and accomplishment reports. The Joint Council is obligated to produce four reports to help improve the overall effectiveness of the agricultural system: (1) a long-term needs assessment (20-30 years); (2) a five-year plan; (3) an annual priorities report; and (4) an annual accomplishment report.

Many of the priorities established in the FY85 Priorities report did not have a major impact on the proposed FY85 budget. Scientific expertise development, which ranked second on the list of the eight highest priorities, had its fellowship grants terminated. Communications technology, ranked third, received no increase in extension technology. Human nutrition, ranked sixth on the list, experienced a major cut in the Expanded Food and Nutrition Program and a small increase in the Human Nutrition Information Service budget. Water management, the seventh ranked, received no increase in funding. Forest, range, and pastureland productivity, ranked eighth, experienced a slight reduction in Cooperation Forestry research and a significant reduction in Forest Service research.

Analysis

The Joint Council's planning process, as outlined in its four reports, is difficult to evaluate. The complexity of the agricultural system obfuscates a clear statement of priorities as is found in another report, Agricultural Research Service [ARS] Program Plan. This limitation may derive from the fact that the ARS Program Plan is concerned with only one part of the system, while the reports of the Joint Council focus on the entire system.

Testifying before the House Committee on Agriculture in June 1984, William B. Lacy, professor of Rural Sociology, University of Kentucky, stated that "Congress and the agricultural research community need to combine effective priority setting with sufficient resources for sustained effort to meet the long-term needs, while retaining the flexibility to respond to urgent short-term problems and coordinating the over all effort." Lacy suggested that policymakers should continually review and analyze the agricultural policy process; include the full range of constituents for agricultural research in the process of developing priorities; establish several multidisciplinary units in which policy research could be conducted; develop methodologies for interpreting scientific, technical, and economic information in order to increase the effectiveness of research efforts; and fund agricultural research at a level more commensurate with its value to society and with its research needs.

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NEW DIRECTIONS FOR THE AGRICULTURAL RESEARCH SYSTEM

Issue

Within the past two years, the agricultural research system has been scrutinized extensively by the General Accounting Office, the Office of Technology Assessment, and the Office of Science and Technology Policy. Their reports point out the need for strong direction and prioritization in the national agricultural research system and for more effective planning and coordination among the components of the system.

Background

The Agricultural Research Service (ARS) released its long-range plan in February 1984 in response to the criticisms made about the agricultural system. The ARS report, Program Plan: Six-Year Implementation Plan (1984-1990), is intended to guide the Department of Agriculture's (USDA) operational planning, resource allocation, and program execution for the next six years. In developing the Plan, the ARS senior staff evaluated agricultural research needs and recommended redistribution of existing ARS resources among major program areas (soil and water conservation, plant productivity, animal productivity, commodity conservation and delivery, human nutrition, and integration of systems). Some of the major proposals in the Six-Year Plan were to: reduce plant production and protection research by 18 percent; devote about 50 percent of the six-year plan to basic research in all areas; reduce substantially most small farm, organic farming, and energy research; and increase human nutrition research and commodity conversion and delivery research.

In October 1984, the Joint Economic Committee held a hearing on "New Directions for Agriculture: The Science and Technology of the Future." The hearing focused on the importance of agricultural technology, innovation, and research and their interaction with future farm policy. In testimony before the Committee, Robert C. Lanphier, President, Dickey-john Corporation, stated that agriculture was the most dynamic, high technology industry in the world. He stressed the need for directing agricultural research to facilitate the assimilation of the emerging technologies in order to provide an adequate supply of food, both domestically and for international trade.

Analysis

The ARS's Six-Year Plan for restructuring the agricultural research system was criticized for not being detailed enough. The Administration's FY85 budget did not respond positively to the proposals outlined in the Six-Year Plan. The budget did not deemphasize plant production research, despite the major cut proposed for this area in the Six-Year Plan. Instead, the area received a subtantial increase. Also, human nutrition research, which was a high priority in the Six-Year Plan, was the only area not given a program increase. The ARS does acknowledge that the Six-Year Plan can be modified as a result of public comments and political considerations. There has been, however, hesitation to implement the plan rapidly due to congressional concern about ARS's ability to conduct meaningful long-range planning and to provide leadership in fundamental aspects of the agricultural sciences.

The Agricultural Research Service has made several organizational changes of differing degrees to define its mission and to improve its capacity to address national research priorities. The Committee might look at the following issues: Is the ARS restructuring itself to function as effectively as possible? What is the distribution of research benefits and the process of determining priorities? What is the adequacy of basic and applied research in the agricultural research system?

EFFECTS OF NEW PLANT BIOTECHNOLOGIES ON AGRICULTURAL RESEARCH

Issue

There is an expectation in the agricultural community that genetic engineering will have a profound impact on the Nation's food and farm system. The impacts of the anticipated breakthroughs in the new plant biotechnologies will exceed those of the development of iceberg lettuce in the 1920s or of hybrid corn in the 1930s. Genetic engineering in plant breeding is expected to add about $5.6 billion to the annual value of crops before the year 2000. But, the biotechnology revolution will come at a price. Plant biotechnology could produce dramatic changes in farm production and agribusiness and in the functions of research and education. Under debate is the adequacy of the Federal efforts for new plant biotechnology research and the consequences of such research for the future of the food and farm system.

Background

In 1983, the National Academy of Sciences Briefing Panel on Agriculture Research Opportunities identified plant biology specifically as a research area that is "likely to return the highest scientific dividends as a result of incremental Federal investments." Planning major research programs requires accurate information about funding and personnel, but reliable baseline data for plant biology have not been available. Findings from a recent NSF study foresee changes in farm production and agribusiness and in the functions of agricultural research and education.

Until the present, every State has been able to afford a conventional breeding program, but every State may not be able to afford a comprehensive plant biotechnology program in the future. The resulting effect may be a limitation on the number of States that can engage in a full-fledged biotechnology program, and a concentration of scientific talent at relatively few public and private institutions.

Probably the most dramatic effect of the new biotechnology will be on the farmer. Production in the seed industry is gradually being moved from the experiment stations to the industrial sector. It is possible that farmers will gradually lose their traditional role as primary clients for plant breeding research. To some extent, farmers have already been replaced by chemical and seed companies. The new biotechnologies have the ability to make farmers dependent on industry in a manner in which they never have before. There is the potential for conflict between the interests of the farmer and those of agribusiness.

Analysis

Several issues appear to require additional public policy consideration. One is the issue of sufficient and equitable sources of funding. In testimony before the House Committee on Agriculture, Lawrence Busch, Co-chair, Committee for Agricultural Research Policy, University of Kentucky, stated, "Perhaps the major policy implication of . . . [the NSF] . . . study is that certain aspects of the new biotechnologies are unlikely to be developed unless Federal money is available for research and education. While State and private funds are already addressing some issues effectively, much of the potential for the new plant biotechnologies will only be realized if Federal monies are made available in a relatively unfettered manner." A second issue is that the new biotechnologies have the potential for altering U.S. agriculture and agricultural research. In addition, there may be unanticipated consequences. Congress may want to intensify its oversight and monitoring of progress and innovations in this area.

ENVIRONMENTAL ASPECTS OF PEST RESISTANCE

Issue

Genetic resistance of insects and other pests to pesticides poses an increasing threat to agricultural productivity. Better knowledge about adaptation mechanisms, alternatives to traditional pest control methods, and the potential role of bioengineered pesticides could help prevent, reduce, or anticipate pest resistance in the future. At issue is the adequacy of Federal support for research on this problem.

Background

Control of pest damage to crops has been hampered in many cases by the development of genetic resistance of pests to particular pesticides. In some cases this may have been due to overuse of pesticides, but more generally, reliance on any single pest control technique might lead to some resistance over a long term. As the use of synthetic chemical pesticides has grown since World War II, pest resistance problems have increased and are expected to intensify. Much research and development within the pesticide industry and other sources has been, and is expected to be, devoted to overcoming this problem of pest resistance to commonly used control methods.

A number of research avenues hold promise. Integrated Pest Management (IPM) techniques have helped to minimize the use of particular pesticides by better calculating the trade-offs between pest damage and cost of controls through scouting programs, identifying beneficial changes in cultural practices, and recommending other changes in cultural practices. Pest resistance problems are also expected to be reduced through greater use of more specific pest controls, such as the introduction or encouragement of natural predators, or the use of microbial pesticides which introduce pathogens specific to the target pest. Genetic engineering holds great promise for the development of predators and pathogens which would target pests of concern.

Analysis

Increasing pest resistance to synthetic chemical control threatens to impact severely American and world agricultural production. Some critics of current agricultural practices argue that the potential for pesticides to foster pest resistance should be considered more explicitly as part of government research and regulatory programs, both domestic and international.

In the future, genetically-engineered organisms hold great promise for overcoming pest resistance problems. Crops might be developed to contain their own "natural" pesticides or insect repellents. Microorganisms or predators might be developed which would affect only pests of concern. Activities of Federal agencies will greatly affect the pace and direction of the research and implementation of the biotechnology-based pest control techniques.

Regulatory efforts will have to balance the potential benefits of biotechnology products with the potential risks of introducing products with the potential risks of introducing often novel species into the ecosystem. This task may prove difficult, however, due to the many uncertainties which will have to be addressed by any regulatory policies.

Programs which have a potential role affecting this pest resistance issue include the registration of pesticide products by the Environmental Protection Agency, research and aid activities of the Department of Agriculture, and the emerging regulatory structures concerning biotechnology products at a number of agencies.

SMALL-SCALE AGRICULTURE AND THE U.S. DEPARTMENT OF AGRICULTURE

Issue

Recent data surveys indicate that the structure of agriculture is increasingly dominated by a growing number of both very small farms and large farms. Farm programs of all kinds have traditionally supported the needs of commercial farming. At issue is whether the USDA should adjust its package of research, education, and other assistance and support programs to address more directly the needs of small farms.

Background

Farm structure can be viewed in several ways, including financial characteristics and farm size. Almost half of the Nation's 2.19 million farms earned less than $10,000 from the sale of farm products in 1982. These small farms account for less than four percent of all farm sales. Further, the average net income is negative for all farms earning less than $20,000, but average off-farm income is substantial when considering farm size.

About 40 percent of the country's farms are smaller than 50 acres. The number of small farms grew by more than ten percent between 1978 and 1982, while the total number of farms declined slightly.

The United States Department of Agriculture is supposed to serve all farmers through a variety of programs that support farm income, provide credit, and enhance agricultural endeavors through research and educational activities. In recent years, critics have questioned both whether the products of research programs encourage farm enlargement and whether research and education programs identify and address the special needs of the small and new farmer. Further, there has been growing interest in alternatives to the traditional patterns of cultivation, fertilization, and pest control, for example, organic farming. These changes have led to criticism that the Department has not altered its program to meet new needs.

Analysis

Congress may wish to explore, primarily through the oversight process, both the implications of the changing farm structure and USDA's efforts to meet the needs of small farmers. Congress might examine the specific research needs of small farmers, and whether those needs are served by current programs, whether small farmers are receiving adequate credit assistance, and whether education and information programs in the Department meet the needs of small farmers. In addition, Congress may wish to examine the more general question of how USDA should assist individuals who do not derive most of their income from farming.

IMPACT OF BIOTECHNOLOGY ON AGRICULTURAL PRICE SUPPORT PROGRAMS

Issue

Investments in biotechnology research have increased rapidly. A wide range of production-increasing technologies might soon become available. Current agricultural commodity programs barely have been able to control surpluses, even with existing technology. Will the emerging new technolgies render existing price support programs unworkable?

Background

Agricultural policymakers have tried to achieve a delicate balance between the need for improvements in agricultural productivity and the problems of adjusting to overproduction and low income in agriculture. In recent years, yields of major crops and overall agricultural productivity have increased at an average annual rate of two percent.

Genetic engineering and biotechnology hold the promise of significantly altering the speed and extent of technological change. A wave of new technology is beginning to emerge that will likely outstrip the mechanical and chemical revolutions in terms of impact on food and fiber production. Scientists believe the greatest impacts will come first for animal agriculture, including such improvements as faster growth rates, less feed per unit of output, increased disease resistance, and more offspring per animal. Biotechnological developments are also expected to impact the crop sector. New crop varieties will have increased resistance to disease, insects, and nematodes and less susceptibility to weeds, variations in temperature, and water availability. Introduction of nitrogen-fixing capabilities into nonleguminous plants may reduce production costs and raise yields.

Analysis

The range of impacts of new technologies, such as those discussed on this page, should be taken into consideration by policymakers. Some policymakers have expressed concern about whether or not sufficient advance warning of rapidly emerging technologies will be available to the public. Who has the responsibility to monitor the adoption of new technolgies and assess their impacts?

Public policies and institutions can affect the manner in which the potential benefits and costs of new technologies are realized and distributed. Will all farmers have access to new technologies? Or will certain private firms monopolize certain technologies in ways that give them control of the production of an individual commodity? Which farms will go out of business if surplus production continues? What are the potential impacts of emerging technologies on food production in other countries, and what will be the resultant impact on U.S. food exports?

Technological innovations can also affect institutional structures, such as the commodity price support programs. Will the current supply management tools provided by these programs be able to cope with rapid increases in productive capacity brought about by new technology?

POST-HARVEST TECHNOLOGY AND MARKETING ECONOMICS

Issue

The labor and capital productivity of the U.S. post-harvest technology and marketing sectors is considered to be poor relative to on-farm productivity. Conversely, there has been a significant decline since 1972 in research funding for this area. But some argue it is unnecessary to increase public research funding, because private firms have sufficient resources to conduct their own research.

Background

Drought, crop failures, and famine in several areas of the world have demonstrated the fact that food is not unlimited and that the United States alone cannot be the breadbasket of the world. Yet millions of pounds of food that could be available for human consumption are never utilized. The U.S. Department of Agriculture (USDA) has estimated that a reasonable reduction in post-harvest losses in the United States alone could increase the available food supply by up to 15 percent, without bringing new land into production.

Post-harvest operations performed on food products account for 70 percent of consumer food costs. Labor costs alone now account for 45 percent of the food marketing bill. The costs to the public of preventing waste in the post-harvest sector are often much less, in terms of dollars and energy, than the cost of increasing primary production. Many potential sources of food are underutilized. Vast amounts of agricultural products become waste, which creates pollution and disposal problems.

New technology is expected to have a significant impact on how agricultural commodities are processed into food and other goods, and on the development of new products. Development of processed foods tailored to the needs of specific groups of foreign markets is an important way to improve the competitive position of the United States in world trade and change the traditional U.S. orientation of exporting raw agricultural commodities.

The USDA has reduced public funding for post-harvest technolgy and marketing economics (PHTME) research in recent years and argued that this work should be assumed by private sector firms. Research by food manufacturers is valuable, but often proprietary. Industry-conducted research is largely applied research. Basic research is done primarily in universities with public funds.

Analysis

A recent OTA report called for a clearer definition of the respective roles for the U.S. Department of Agriculture, the State Agricultural Experiment Stations, and private industry firms in a total PHTME research program. Observers are concerned about whether consumers will continue to receive the benefits of technological change if public sector research efforts continue to erode. Some industry spokesmen have complained that unnecessarily restrictive regulations have hampered new developments, slowed their adoption, and thereby increased food costs.

4. ENERGY: ADVANCED AND OTHER R&D

See also item:

6.5 REEXAMINING ENERGY AND ENVIRONMENTAL POLICY AND RESEARCH

UNITED STATES SYNTHETIC FUELS CORPORATION

Issue

The U.S. Synthetic Fuels Corporation (SFC) is likely to submit its required comprehensive strategy, probably during the later part of the first session of the 99th Congress. The Congress is likely to respond to SFC's strategy by reshaping its own National Synthetic Fuels Policy based on an array of factors including an assessment of SFC's actions, progress, and policies as well as the Federal budget situation and world energy conditions.

Background

Title I of the Energy Security Act (P.L. 96-294) created the SFC to accelerate the commercialization of an environmentally acceptable and economically feasible synfuels industry at the least cost to the taxpayer. To date, SFC has issued four general and several targeted solicitations--including those for coal-water mixtures, Eastern U.S. coal, coal gasification, and oil shale projects--requesting project sponsors to submit proposals for financial assistance. About 120 groups responded with proposals of widely varying quality. The Corporation has rejected most of these proposals because the sponsors failed to meet SFC's criteria for demonstrating project strength and maturity or because the sponsors were unable to advance their projects toward commercialization. However, SFC has, to date, provided financial assistance to two projects, the Cool Water and the DOW-Syngas projects.

SFC's Board of Directors is now determining how it wants to allocate the remainder of the Corporation's obligational authority, some $8 billion. To guide its future actions, the Board recently approved a statement of objectives and principles and is working on a new "Business Plan." Several congressional committees are likely to review carefully these documents as well as the Corporation's Comprehensive Strategy.

According to the Energy Security Act, this strategy report must describe the economic, technological, and environmental aspects of synfuels projects that have been granted financial incentives by the SFC, and must present the Corporation's longer-term objectives and its schedule to achieve them. In addition, SFC's strategy is to emphasize private sector responsibilities and to describe how specific limitations will be placed on SFC's involvement in future synfuels projects.

Analysis

The 99th Congress is likely to use SFC's comprehensive strategy as a starting point for reshaping the future course of National Synfuels Policy. In its deliberations, Congress will, no doubt, consider many factors, including SFC's track record, whether a federally-supported synfuels commercialization program is still needed in view of the current as well as the projected world energy situation, and the costs of such a program in relation to other possible uses of scarce Federal dollars.

The Committee might also review SFC's comprehensive strategy in light of its possible implications for federally-supported fossil energy R&D. Does SFC's experience indicate the need to intensify the search for more competitive coal liquefaction processes? Should additional funds be allocated to advance in situ tar sand processing systems? Should additional public funds be allocated for research on oil shale retorting dynamics and materials problems?

CLEAN COAL TECHNOLOGY RESERVE--WILL FUNDS BE APPROPRIATED?

Issue

In P.L. 98-473, Congress created a $750 million "Clean Coal Technology Reserve," which the Department of Energy (DOE) may use to help industry demonstrate the commercial feasibility of various coal-based technologies. Although the Administration is likely to oppose any appropriation for this new initiative, many of its supporters want to ensure that the program moves forward. The 99th Congress will likely decide the amount, if any, of appropriations specified for this program.

Background

During the 98th Congress, several congressional committees held hearings on the status of DOE's fossil energy research, development, and demonstration program. The results of these hearings, together with a growing dissatisfaction over the progress of the United States Synthetic Fuels Corporation, convinced many Members of Congress that DOE's program needed to be stimulated. A consensus emerged that a new effort was needed to fill the gap between DOE's basic and applied research programs on coal technologies and industry's efforts to commercialize large-scale coal projects.

Partly as a result of this consensus, the 98th Congress created the 'Clean Coal Technology Reserve," which DOE may use to provide funds for the construction and operation of plants that are designed to demonstrate the commercial feasibility of various coal technologies. Examples of technologies eligible for support include advanced coal preparation and cleaning, limestone injection multistage burners, regenerable fuel gas desulfurization, and atmospheric fluidized bed combustion systems for utilities. Funds taken from the reserve cannot be used to support on-going research and development projects and must be used only in conjunction with substantial industrial support, that is, cost sharing.

In response to this Act, DOE has solicited "Statements of Interest and Informational Proposals" from the private sector regarding this program. DOE expects to prepare a report to Congress by May 1, 1985 which will be designed to analyze the proposals submitted in response to its solicitation, assess the various technologies involved, and identify the extent to which Federal incentives will accelerate the commercialization of these technologies. Currently, DOE has no resources to fund any of the proposed activities related to this program and does not anticipate funding any of the proposals submitted.

Analysis

Annual funding for activities related to the use of the "Clean Coal Technology Reserve" are determined by appropriations by the Congress. In view of the current budgetary situation and likely requests for reductions in DOE's fossil energy budget, the Administration is unlikely to request appropriations for the "Clean Coal Technology Reserve." The Administration may argue that the private sector is proceeding with the commercial demonstration of many of these technologies without Federal support. On the other hand, many congressional supporters of this program are likely to insist on funding at least a portion of this program.

If funds are appropriated, the 99th Congress is likely to oversee the pace at which the Administration implements this new program and the Administration's willingness to actually commit funds from this reserve.

A REVIEW OF THE TEN-YEAR HISTORY OF THE FEDERAL SOLAR PROGRAM: THE EFFECTS OF PAST, PRESENT, AND FUTURE SOLAR POLICY ON TECHNICAL AND COMMERCIAL PROGRESS IN SOLAR DEVELOPMENT

Issue

Federal solar policy has evolved piecemeal over the past ten years with the annual budget review being the principal policymaking tool. Recognizing 1985 as the tenth anniversary of the present solar program, it may be an appropriate time to examine the effects this approach to policy formation has had on efforts to establish a commercial solar market. How has the lack of a long-range, coherent policy for solar development affected Federal and private sector efforts? Is the current "free-market" policy consistent with the policy framework established by Congress through legislation and budget reviews over the past ten years? Is the free-market policy working in the case of renewable energy technology developments, or does the effort require a more active Federal role?

Background

Federal solar energy programs and policy have evolved over the past ten years through a patchwork of legislative initiatives, annual budget reviews, and executive branch actions. It has been a turbulent, sometimes contentious, period with Congress and the Administration in office frequently at odds over general policy directions as well as minute budget details. A policy framework calling for an aggressive Federal effort in solar R&D and commercialization was established through numerous bills initiated by Congress and enacted during the mid- and late 1970s. The program during that period was characterized by expanding annual budgets and an expanding Federal role in commercialization and development activities. The Reagan Administration, acting largely through the annual budget review process, replaced the congressionally-mandated solar commercialization policy with a "free-market" policy. Under this policy, the budget for solar development was reduced precipitously and the Federal role in solar commercialization all but disappeared. The free-market policy limits the Federal role in solar to long-range research projects; the private sector is charged with product development and commercialization, thereby ensuring that only the most economically efficient technologies will enter the market.

Analysis

In view of the turbulent history of the Federal solar energy program, and particularly in view of the changes wrought by the Reagan Administration over the past four years, an examination of the present policy framework for solar R&D may be in order. The current program continues to evolve through the annual budget review process. Lacking a policy framework in which to develop, the program is buffeted each year by outside pressures which often are unrelated to the allocation of the energy budget. This piecemeal approach to policy may be detrimental to the continuity and effectiveness of the Federal solar program, and in the long term may affect when and how solar technologies enter the marketplace. Discontinuities in Federal policy almost certainly disrupt technical progress and cause the private sector to suffer unanticipated costs. Furthermore, the private sector is less likely to conduct costly R&D activity in Federal program areas which lack policy continuity. With Congress and the Reagan Administration having reached something of an impasse with respect to Federal solar policy, Congress may wish to consider the merits and risks of a policy/budgetary framework for the Federal solar program covering a several-year period.

THE EFFECT OF TAX REFORM ON RENEWABLE ENERGY INDUSTRIES

Issue

Treasury's tax reform proposal is designed to eliminate inequities in the energy market caused by Federal tax subsidies which favor one form of energy over another. The consumer-oriented segment of the renewable energy industry applauds tax reform because it holds the possibility of a fair tax system. The industry segment opposes it, saying that it leaves many inequities in place and discourages investments in renewable energy. To what extent will tax reform even out tax and pricing inequities in the present energy market? Will the renewable energy industry be more or less able to compete after tax reform? What special subsidies does nuclear energy now receive? How will nuclear energy be affected by tax reform?

Background

The National Energy Act (later amended by the Windfall Profit Tax Act) recognized that fossil and nuclear sources received tax subsidies and other forms of Federal assistance which gave those forms of energy an unfair market advantage over technologies based on renewable energy sources. The Act attempted to even out inequities in the energy market by creating special tax subsidies for solar and other renewable energy technologies. Tax reform takes the approach that equity can be better achieved by eliminating all subsidies, thereby creating an "even playing field" in which all energy forms compete equally on a cost basis.

Analysis

Tax reform implies that renewable energy would compete equally with oil, gas, coal, and nuclear. However, the Treasury proposal does not address all market inequities, it does not recognize the need to promote domestic sources over imports, and it does not recognize the special market needs of emerging technologies. The Treasury proposal may well leave the renewable energy industry at a distinct disadvantage in competition with fossil and nuclear sources, particularly in the utility and industrial markets. In the utility market, renewable energy must ultimately compete with coal and nuclear, which are not as affected by tax reform as oil and gas. The principal obstacle to competitiveness in the industrial market is industry being able to write off conventional fuel costs as a business expense. Fuel expensing is not addressed in the Treasury proposal. Because renewable energy technologies are relatively untried, industry and utilities preceive them as being a high-risk investment. In order to penetrate these markets, renewable energy technologies must be able to show a much higher rate of return on investment than conventional energy technologies. Accelerated cost recovery and the business investment credit helped high-risk, capital-intensive renewable energy technologies over this hurdle, but under the tax reform proposal both of these beneficial incentives will be eliminated. In the residential sector where solar is already competitive on a life-cycle basis with oil, gas, and electricity in certain markets, the primary obstacle to investments has been the high initial cost of installations. Tax credits helped overcome this obstacle. However, unless consumers are educated in life-cycle cost accounting, the high initial cost and the long payback period required to recover this cost could seriously impede the residential solar market after the credits expire. The impacts that tax reform may have on energy markets are uncertain and highly speculative. The renewable energy industry is at a fragile stage of development. Unless special precautions are taken to protect it, it may well be harmed more than it is helped by tax reform.

FEDERAL SOLAR TAX CREDITS: HOW WILL THEIR EXPIRATION AFFECT THE INDUSTRY, TREASURY RECEIPTS, AND THE FEDERAL SOLAR ENERGY PROGRAM?

Issue

The solar industry contends that it has not yet achieved a sustainable growth rate and that it will be set back significantly if Federal tax credits for solar energy investments are allowed to expire on schedule on Dec. 31, 1985. While extending the credits may initially reduce Treasury revenues, proponents of an extension say that offsetting revenues generated by a viable industry, and long-term benefits such as reduced oil imports, will outweigh the cost of an extension. How seriously will the industry be hurt if the credits are not extended? And could a viable industry generate sufficient offsetting revenues to justify an extension? What are the prospects that the industry will be self-sustaining after the extension period?

Background

The "solar" industry is a loose affiliation of diverse sub-industries which have in common a reliance on solar energy, in any one of several manifestations, for a power source. Four principal industries are generally included under the solar rubric: the solar heating, cooling, and hot water industry; the wind electric industry; the photovoltaics industry; and the solar thermal electric industry. The estimated cost of extending the credits through 1990 ranges from $3 to $8 billion. Not included in the estimate, however, are possible offsetting Treasury gains which might be derived from fewer tax deductions taken for conventional fuel expenses, an improved trade balance resulting from reduced oil imports and increased solar product export, and expanded investment in a labor-intensive industry.

Analysis

The Reagan Administration notes that the credits are a drain on the Treasury and are inconsistent with its "free-market" energy policies. However, until Federal subsidies for competing fossil and nuclear fuel sources are eliminated, the current energy market is not "free." The solar credits were intended to even out disparities in energy market caused by the Federal subsidization of competing sources.

The sudden loss of the Federal solar energy tax credits may have both immediate and long-term, potentially adverse, effects on the industry. These effects could be cumulative and may markedly delay the time at which solar energy systems can be expected to contribute significantly to the U.S. energy mix. Sales projections for all solar technologies will be reduced in the absence of the credits, leading manufacturers to delay or cancel new production capacity. To the extent that hardware costs are driven by production levels, costs will not decline as rapidly as they would have in the presence of tax credits. Reduced expectations may significantly reduce the incentive for industry to conduct its own R&D, or to participate in the Federal program. The Federal R&D program may become less efficient and more costly to the extent that it is dependent on participation and feed-back from the private sector. The value of the Federal program may be reduced to the extent that the industry is smaller and less dynamic after the credits and therefore less able to carry out its assigned tasks of industrialization, commercialization, and product development.

The free-market approach to energy development holds that, in theory, when Federal price controls, subsidies, and stringent regulations are removed, new energy technologies will be developed and introduced at rates consistent with their economic potential. Tax credits distort the market, possibly leading firms to undertake investments that are uneconomic at current prices, which may divert workers, capital, and initiative from more productive uses elsewhere in the economy. Since they reduce the cost of specific alternatives, credits may discourage other, potentially more efficient, alternatives. Free-market proponents conclude, then, that if a solar wind technology needs a special subsidy to survive, that technology should be allowed to die, thereby allowing the more efficient sources of energy to continue.

EXPIRATION OF THE FEDERAL SOLAR ENERGY TAX CREDITS: EFFECTS ON THE WIND INDUSTRY

Issue

The rapid growth of the wind turbine industry since the early 1980s was made possible by large Federal and State subsidies and other economic incentives. The wind industry is concerned that the loss of tax subsidies and other changes in Federal tax policy will jeopardize the tax-sheltered wind park market which accounts for 98 percent of industry sales. How will the shift from a tax-oriented to a business-oriented operation affect the industry's growth? How will the loss of the credit affect the outlook for volume production, or the trend toward large, megawatt systems of possible interest to utilities?

Background

A single market segment--the California wind parks--is largely responsible for the rapid growth of the U.S. wind industry in the early 1980s. State and Federal tax subsidies and other favorable tax policies make these parks an attractive investment opportunity for third-party investors seeking tax shelters. Wind parks now account for 98 percent of all U.S. installations and 90 percent of all wind installations world-wide; virtually all of the U.S. wind parks are located in California. Driven by the wind park market, world-wide sales have jumped from a few million dollars in the late 1970s to $159 million in 1983 and $405 million estimated for 1984. Wind turbine costs are still too high for any penetration of either the utility or the grid-connected residential market. Indeed, without economic subsidies, no segment of the wind industry would be economically viable at present.

Of the approximately 100 U.S. turbine manufacturers, about 70 supply small turbines. Most of the small-turbine manufacturers are small, undercapitalized firms which are struggling to stay competitive in a limited, depressed market. Intermediate-size turbines for wind parks dominate industry sales. About 30 companies are active in this market with six manufacturers accounting for 95 percent of all sales in 1983. The large-turbine industry in the United States is moribund, if not dead. No sales have been made to utilities and utilities show no interest in purchasing large (or intermediate) turbines for power generation.

To help ensure its continued growth, the wind industry seeks a phase out of the present 15 percent Federal business tax credit over the next five years rather than an abrupt termination of the credit as scheduled. It also wants a five-year extension of the 40 percent residential credit, and the ceiling on qualifying expenditures increased to $20,000.

Analysis

Due to the heavy tax credit orientation of wind park developers, and the importance of that market to the wind industry as a whole, the continued growth, and even survival, of the industry after the credits expire may be in doubt. The expiration of the credits will almost certainly lead to a major shakeout of the industry. There may be a period when few sales are made, leading manufacturers to cut back drastically or cease all operations. With future sales in doubt, it will be difficult for the industry to attract venture capital. To the extent that costs are reduced through increased production levels, costs will not decline as rapidly as they would have with the credits. The firms that survive the shakeout should be well positioned to develop and deliver lower-cost, more efficient wind systems. Ultimately, the market outlook for wind should be substantially improved by the availability of such systems.

EXPIRATION OF THE FEDERAL SOLAR ENERGY TAX CREDITS: EFFECTS ON THE PHOTOVOLTAICS INDUSTRY

Issue

The present market for photovoltaic systems is limited to off-grid, low-power devices. However, the real potential of photovoltaics lies in the residential/utility grid-connected market. Industry strategy for entering this market in the early to mid-1990s is heavily dependent on the availability of Federal tax subsidies (credits) through the 1980s, and on utilities being made eligible for the credits. How will the industry's timetable be altered if the present credits are not extended? Is the survival of the industry in question without the credits?

Background

A small, but stable, market for photovoltaic (PV) systems has been established in low-power, remote (off-grid) applications. However, the domestic PV market is too small to sustain healthy competition and vigorous growth in the industry, and the U.S. share of the world market is declining rapidly in the face of highly subsidized foreign competition. Because costs are still high, the current world demand is considerably less than the U.S. industry's capacity to produce. To keep pace with the competition and the rapid pace of technical innovation, U.S. firms must spend large sums annually on research and development in new materials, new technologies, and new production processes. As a consequence of stiff domestic and foreign competition, a small market at current PV prices, and high R&D investment requirements, there is little or no profitability in the PV industry.

The industry hopes to broaden its remote power markets and expand into the grid-connected residential/utility market. To do this, it is seeking an extension of the residential and business solar tax credit for PV investments; a provision of law to make utilities eligible for the business credit; and an increase in the business credit. Some industry factions also support a "buy America" policy which would exclude foreign systems from the subsidy. With subsidies to help it through the transition from off-grid to grid-connnected markets, industry representatives believe that it can achieve the volume production needed to reduce costs to levels competitive with grid power in non-supported markets.

Analysis

Industry projections for 1986 show that, without the credits, sales would be reduced by about half; by 1990, sales may be four to six times less than they would be with the credits. With reduced expectations for sales, the industry will almost certainly be less dynamic and diverse. Industry may reduce its R&D effort and also shift the focus of its R&D to foreign markets where tax subsidies have no direct effect. New production facilities may be delayed. Costs, to the extent they are driven by production levels, may not decline as rapidly as they would have with credits. Large-scale third-party investment projects in 1982 and 1983 accounted for an important share of the U.S. market and made it possible for the industry to achieve cost reductions through volume production. Such sales may be greatly delayed or eliminated after the credits expire.

In the absence of a federally-subsidized market, industry attention will probably shift to the development of systems better suited to present markets for PV systems, which are in developing countries and remote commercial applications in this country. These markets have not been fully exploited and should be sufficient to sustain the industry through the post-credit period. With proper attention and development, these markets may provide the bridge that the industry needs to the grid-connected domestic market. The consequence of a credit cutoff, therefore, is likely to be a delay in achieving cost competitiveness in the domestic grid-connected market, not a private sector pullout from the industry.

EXPIRATION OF THE FEDERAL SOLAR ENERGY TAX CREDITS: EFFECTS ON THE SOLAR SPACE AND WATER HEATING INDUSTRY

Issue

The solar tax credits have been the key to the solar space and water heating industry's rapid growth from the late 1970s to the present. Because most sales are driven by the credits, the industry is apprehensive about its future in the absence of a direct Federal subsidy. It is seeking to have the credits phased out over the next three to five years rather than being terminated at the end of 1985 with no follow-on. Can the industry survive and grow without the credits? Does the industry generate enough offsetting revenues and indirect benefits to merit a credit extension?

Background

The solar space and water heating industry is the largest solar industry, with sales of all systems (active and passive) estimated at $700 million to $1 billion in 1983, and an extensive infrastructure. Hot water heaters dominate all sales categories, accounting for 55 percent of the collector volume sold in 1983, up from 40 percent in 1982. Approximately 225 collector manufacturers form the core of the industry. While some large Fortune 500 firms are in the business as an adjunct to other operations, approximately 80 percent of all solar firms have fewer than 20 employees. The industry is relatively mature, but still experiences a high turnover rate due to low rates of return on investments, acquisitions or failures, and the relatively low cost of entry into the market.

The industry has not grown as rapidly as anticipated when the credits were first put into place. Its slower-than-expected growth rate has been attributed to the recession in the early 1980s, to high interest rates which caused consumers to delay investment decisions and made it difficult for the industry to obtain venture capital for expansion and research, to oil prices which did not rise, and to Administration policies which reduced the Federal role in solar commercialization while continuing to subsidize markets for fossil and nuclear sources. The industry is concerned about the effects of a sudden cutoff of its subsidy and is, therefore, seeking a phased reduction of the present 40 percent residential credit over the next five years.

Analysis

Markets for active systems and passive water heaters are heavily dependent on the Federal solar tax credits. Sales of these systems are expected to drop appreciably when the credits expire. Because the industry is made up of so many small, underfinanced, marginal firms, the shock of the credit expiration is likely to precipitate a major industry shakeout. However, the firms that survive may form the basis of a stronger, more efficient industry than exists today. Since pool heaters (representing about 30 percent of the collector volume sold in 1983) and passive solar space conditioning systems (an estimated market of 50,000 homes in 1986) are generally not eligible for credits, these markets should not be directly affected. Small firms which use a sales approach oriented entirely around the credits will undoubtedly experience the most severe effects. A variety of factors, many of which are beyond the industry's control, will determine how soon the industry can recover from the loss of the credit.

ALLEGED ABUSE OF FEDERAL SOLAR TAX CREDITS BY SOLAR INDUSTRIES

Issue

The solar energy industry has a credibility problem which may affect its future growth and its prospects for winning an extension of the Federal solar tax credits in the 99th Congress. Part of the problem arises from the use of certain tax-oriented marketing practices by what appears to be a minority of firms in the solar heating and wind energy industries. Not extending the tax credits would eliminate any alleged abuses of the Federal credits. In the event the credits are extended, however, can the industry eliminate the problem through self-policing? Does legislative action need to be taken to correct the problem?

Background

In the case of the solar heating industry, the problem apparently involves rebates to homeowners who buy over-priced water heating systems. Since State and Federal tax credits are determined by the installed system cost, inflating that cost will entitle the purchasers to tax credits in excess of the amount he or she would have received had the system been sold at its fair market value. The dealer offers the homeowner a rebate for a variety of reasons, such as the house being a demonstration site, which makes the net after-tax cost very attractive. The homeowner pays the seller a nominal amount for the solar installation, plus an amount equal to the tax credits to which he or she may be entitled based on the installed (inflated) cost. Inflating the value of the solar system in order to obtain a larger tax credit is a questionable business practice at best and may constitute tax fraud. The IRS is investigating this practice. If it determines that the practice is fradulent, homeowners may have to pay back the excess credit plus penalties.

In the wind industry, there have been scattered reports that some wind energy developers were taking credits for low-quality machines without being able to construct a properly operating facility, and that some wind machine salesmen were offering dealerships and demonstrator models without any expectation of delivering working turbines. There have also been charges that the current tax arrangements for wind parks, because they are so generous, constitute a giveaway to developers.

Analysis

While there have been no formal charges of tax fraud in either the wind or solar heating industry, the questionable business practices used by a few opportunistic firms has led to some disenchantment with the renewable energy industry among consumer and environmental groups and State and Federal legislators. Industry leaders recognize the problem and are attempting to deal with it through self-policing. The American Wind Energy Association has established an ethics committee to police the industry and point out potential abuses, such as improper use of the tax credits. Solar industry support groups have publicly acknowledged the problem and have called on the industry to move aggressively to clean itself up. The industry has also proposed a ceiling of $6,000 on expenditures for solar water heaters--a $4,000 reduction in the present ceiling. Basing the credit on the dollar amount invested opens the system to abuse. If the industry cannot deal with the problem satisfactorily, alternatives to the present credit structure may need to be considered. One possibility that has received some attention in the Congress with respect to passive solar energy systems is a credit based upon performance rather than dollar value.

SOLAR ENERGY BASIC RESEARCH IN THE DEPARTMENT OF ENERGY: NEED FOR A PROGRAMMATIC FOCUS?

Issue

Administration energy policies introduced in 1981 would appear to direct the Federal solar program toward a greater emphasis on basic research. However, DOE has not established a programmatic focal point for basic research within the solar branch, nor has it established a mechanism for coordinating the basic research of the solar branch and the Office of Basic Energy Sciences (BES). Also, the solar program's current emphasis on applied research would appear to be inconsistent with Administration policy objectives. What is DOE's current level of effort in solar basic research? What mechanisms exist for coordinating the research activities of BES and the solar branch? What promising projects or areas of research might be undertaken through a more focused and coordinated approach to solar basic resesarch?

Background

Two offices within DOE have a functional responsibility for conducting solar or solar-related basic research: the Office of Basic Energy Sciences (BES) and the Conservation and Renewable Energy (CE) Branch. BES supports solar basic research only as part of its broad mandate to conduct high-risk, potentially high-payoff research in all areas that may benefit DOE's mission. BES estimated that at the end of 1983 it had approximately $30 million in on-going research related to renewable energy (largely solar) technology. CE has overall responsibility for developing solar technologies, but its current emphasis favors applied research and engineering development. CE estimated that, at the end of 1983, it had from $1 to $3 million in on-going solar basic research. Consequently, most of CE's research is "applied," not "basic" as the Administration's policy shift would suggest. The BES research effort is organized administratively by scientific discipline--such as materials, photochemistry, mathematics, and engineering-while the CE effort is organized by energy technology. CE has no formal mechanism for planning, prioritizing, initiating, conducting, coordinating, or even identifying its basic research activities. Neither CE nor BES coordinates its solarrelated basic research with the other, nor does either have a formal mechanism for sharing the results of its research efforts.

Analysis

The lack of a programmatic focus for solar basic research may be affecting the agency's ability to identify and direct its resources toward the most important basic research needs; avoid duplication of effort between CE and BES; and transfer research results to the research community and the industrial sector. With no structured program on which to focus, it may be difficult for industry and the research community to couple with or to anticipate Federal renewable energy basic research in formulating their own plans, or to contribute effectively to the substance and direction of the Federal effort. A 1982 Energy Research Advisory Board report, Solar Energy Research and Development: Federal and Private Sector Roles, concluded that CE should identify and support basic and applied research which directly support its technology areas. In addition, CE should continue to receive support from, and remain in close coordination with, BES programs. The report identified research needs in materials, degradation mechanisms, and interfaces, and recommended that DOE take a leading role in supporting university solar basic research and education.

5. ENERGY: NUCLEAR R&D

See also item:

6.5 REEXAMINING ENERGY AND ENVIRONMENTAL POLICY AND RESEARCH

LIQUID METAL REACTOR RESEARCH AND DEVELOPMENT

Issue

DOE is shifting the emphasis of its liquid metal reactor research and development program from demonstrating reactor designs and fuel cycles for breeding substantial quantities of fissionable material to research on new concepts capable of reducing generating costs and improving safety. At issue for Congress is oversight of the new strategy as well as determination of the pace and funding level for liquid metal reactor research and development.

Background

Congress' rejection of funding for the Clinch River Breeder Reactor (CRBR) at the end of 1983 was a defeat for DOE's strategy for liquid metal reactor development. That strategy had focused on demonstrating a large-scale reactor and associated fuel cycle capable of breeding substantial quantities of fissionable materials. Large, complex breeder reactors were seen to be uneconomic because moderate uranium prices for the foreseeable future appeared to preclude fuel cycle savings from offsetting the projected high capital costs of these breeders compared to existing reactors.

During FY84, DOE began to develop a new strategy based upon the technology of the breeder program, but with its primary emphasis on reducing capital and operating costs, shortening construction schedules, and improving safety through innovative use of liquid metal reactor technology. To provide a focus for the new strategy, DOE issued a request for proposals (RFP) inviting reactor designers to submit ideas for "innovative and advanced" breeder reactor concepts. Four proposals were submitted and two of them were selected to receive about $12 million in FY85 in support of conceptual design efforts.

Many of the activities of the old breeder program are generic to all liquid metal reactors and could contribute to the current strategy. On the other hand, a sizeable portion of the program was justified only in support of a near-term demonstration of a large-scale breeder. Even without CRBR, the FY84 appropriation for DOE's breeder reactor program was $423 million. For FY85, breeder reactor funding was reduced to $305 million. A further reduction is likely for FY86 as the emphasis of the program continues to shift from support of a near-term demonstration project to a longer-term research and development program.

Analysis

The questions to be addressed by the Congress include: Is the new liquid metal reactor R&D strategy sound and the program well coordinated? Should the United States abandon development of large-scale breeder reactors? How can the United States benefit from foreign breeder reactor development programs that continue to focus on demonstrating large-scale reactors? How can the existing facilities of the breeder program be used most effectively? Is there proper balance between the liquid metal reactor program and DOE's other reactor R&D efforts? Is there proper balance between R&D on reactors and on fuel cycles? And, what is the appropriate funding for these activities?

OVERSIGHT OF DOE'S URANIUM ENRICHMENT PROGRAM

Issue

The U.S. uranium enrichment enterprise, operated by the Department of Energy (DOE), faces challenges from foreign competition and a depressed market for enrichment. Recent and anticipated DOE decisions on the marketing and production of enriched uranium may have profound impacts on the future of the enterprise. At issue is congressional oversight of those decisions.

Background

Before uranium can be used in nuclear reactors, it must undergo a process called enrichment. DOE supplies uranium enrichment services to domestic and foreign utilities, on a cost-recovery basis, from plants that were originally built to enrich uranium for nuclear weapons. The expenses and the revenues of the enrichment enterprise are each about $2 billion per year.

The enrichment enterprise is in serious financial trouble. Nuclear plant cancellations have greatly reduced the demand for enrichment and there is a worldwide glut of enrichment capacity. The United States, which had a near monopoly on enrichment sales before 1978, has now lost a large share of the export market to foreign competition. The lost revenue due to the depressed market makes it difficult to finance construction of new, more efficient enrichment plants which are needed in the long term if the United States is to remain competitive as an enrichment supplier.

In an attempt to maintain its market share, DOE recently issued a new contract for enrichment sales that includes a ceiling on the price of enrichment. The contract has been a marketing success, but critics of the contract claim that it is too favorable to the customers and will not allow DOE to meet its statutory mandate of full-cost recovery. Critics also claim that the contract did not undergo required public and congressional scrutiny before issuance.

Regarding enrichment production, DOE faces a key decision. In May 1985, DOE is scheduled to select either an advanced gas centrifuge (AGC) technology or an atomic vapor laser isotope separation (AVLIS) process for further development and possible replacement of its existing plants, which use a diffusion process. Development of either process is predicted to reduce production costs in the long term, but to incur capital costs in the short term, at a time when enrichment revenues are low and capacity is not needed to meet demand.

The atmosphere in which the decision is being made is highly charged politically, because billions of dollars are at stake for the companies involved and the communities in which production facilities are or may be located. The decision is complicated by the on-going construction of a gas centrifuge enrichment facility near Portsmouth, Ohio. About $2.4 billion (of a total cost of $10 billion) has been spent on that facility which is being fitted with an early version centrifuge that is inferior to either the AGCs or the AVLIS process.

Analysis

Questions to be addressed by Congress in its oversight of DOE include: Is the new enrichment contract valid? Is the ceiling price sufficient for cost recovery? Which advanced enrichment technology is the most promising for future development? When should a diffusion plant be shut down, and which of the three existing plants should it be? How rapidly should new enrichment production capacity be built? And what should be done with the gas centrifuge plant under construction in Ohio?

In addition, Congress may examine issues regarding transfer of the enrichment enterprise to the private sector. Many observers believe that the enrichment business could be run more efficiently by the private sector than by the Government. However, past efforts to "privatize" enrichment have been unsuccessful. DOE has said that it will present proposals for increased private sector participation in enrichment with the FY86 budget.

OVERSIGHT AND FUNDING OF MAGNETIC FUSION R&D

Issue

Advances continue to be made in magnetic fusion energy research. However, the next generation of fusion development facilities will be very expensive. At issue is congressional oversight of the pace and direction of the fusion program and allocation of funding for fusion.

Background

Nuclear fusion is a potential source of energy for generating electricity which uses low-cost, inexhaustible fuels and may pose lesser environmental and safety problems than coal or nuclear fission. However, the technical feasibility of fusion has not yet been demonstrated and the cost of energy from fusion is highly uncertain. The Department of Energy (DOE), the predominant source of funding for fusion R&D in the United States, supports about six major centers for magnetic fusion research and several small university-based research programs. Progress in fusion science has been good during the past several years. One major facility recently completed and another nearing completion are expected to achieve conditions under which more energy can be produced than it takes to sustain the reaction (a condition called energy breakeven). Most scientists believe that the next logical facility would be one in which the fusion reaction could be made self-sustaining (a condition called ignition). Such a facility is estimated to cost $1-2 billion.

In 1980, Congress set ambitious goals for fusion development in the Magnetic Fusion Energy Engineering Act (P.L. 96-386). The Act called for a doubling in constant dollar funding for fusion within seven years and operation by 1990 of a fusion engineering device (FED), which was essentially an ignition facility. However, these goals have not been achieved. The FY85 appropriation for magnetic fusion of $440 million is the lowest level in constant dollars since 1976, and DOE does not plan to build a FED. A widely circulated draft of DOE's 1985 Magnetic Fusion Program Plan calls for constant funding for fusion R&D for the next five years and delaying a decision on whether to proceed with an ignition facility until 1990. The draft plan and earlier plans with similar goals have been heavily criticized by fusion scientists who believe that the program could move much faster if funding were available.

Analysis

The salient question to be addressed by the Congress regarding magnetic fusion R&D is: how much money to spend? Fusion is not a near-term energy option. The most optimistic fusion proponents do not believe that fusion can make a major contribution to U.S. energy supply before 2020. More pessimistic forecasters predict that the contribution from fusion will be much later, if it occurs at all. It is difficult to determine an appropriate funding level for such a high-risk, long-term research program. However, that is precisely the type of program that DOE's National Energy Policy Plan states is appropriate for Federal funding.

Because of the very high cost of the next generation of fusion R&D facilities, DOE and others have expressed interest in the possibility of joint international funding of the next stage in fusion development. Fusion programs comparable to that in the United States are underway in Japan, Europe, and the Soviet Union. International collaboration among fusion scientists is very well developed, and a recently completed European facility provides a successful example of collaboration among several nations. Congress may want to look further at the possibilities and the problems of joint international funding of a new fusion facility.

NUCLEAR REACTORS FOR SPACE

Issue

In February 1983, officials of NASA, DOE, and DOD signed an agreement establishing a space nuclear reactor development program, called the SP-100 program. At issue is whether there are near-term missions that require a reactor in space, the safety of reactors in space, and the pace and funding level for the SP-100 program.

Background

Beginning in 1955 the United States spent several hundred million dollars on the Space Nuclear Auxiliary Power (SNAP) program for developing a nuclear reactor to provide electricity in space. The program was terminated in 1973, after one partially successful reactor flight test, because no near-term missions were envisiaged with great enough electric power needs to justify the use of a nuclear reactor. The advent of the Space Shuttle rekindled interest in a space nuclear reactor and spurred the establishment of the SP-100 program.

The goal of the SP-100 program is to develop a 100-kilowatt (kw) reactor, based upon modest extensions of available technology. That power level might be suitable for use on a small space station or with higher-powered communication or remote sensing satellites than now are used. Development of a 100-kw space reactor, through ground testing only, is estimated to take a minimum of five years and cost at least $350 million. Larger reactors--in the megawatt range-which could be needed for space-based manufacturing or space-based weapons, would require new materials and designs requiring considerably more time and money to develop.

Critics of space reactor development note that the currently planned space station is to be solar powered. They claim that there are still no space missions planned which require more power than can be economically provided by means other than nuclear fission. Critics also are concerned about the radiation hazard upon return of a reactor from space. Proponents of space reactor development foresee the evolution of space stations with higher power requirements than the first station and believe that other high-power-requirement missions would be planned if the power source were available. Regarding safety, the director of the SP-100 program has stated that the United States would place reactors only in orbits high enough for the radioactivity to decay to safe levels before the reactor reentered the Earth's atmosphere.

Analysis

The SP-100 program is currently in the conceptual development phase. Three designs have been undergoing evaluation. Tests and analyses of the feasibility of the three designs have been timed to support selection of one concept for further development in mid-1985. A decision on whether to proceed to a ground engineering prototype demonstration has been scheduled in the context of the FY86 budget.

In order to proceed, substantial increases in funding (above the current $15 million-per-year level) would be necessary for detailed design activities and ground testing facilities. The major issues the Committee may wish to consider are whether the potential uses of a space nuclear reactor justify a major development program at this time; whether emphasis in the space reactor program should be on near-term development of a 100-kw reactor or longer-term research on high-powered, space-based reactors; and which, if any, of the three competing 100-kw designs show sufficient promise for further development.

PROSPECTS FOR U.S. ASSISTANCE TO CHINESE NUCLEAR POWER

Issue

The Reagan Administration has negotiated an agreement for nuclear cooperation with the Peoples Republic of China. If this agreement takes effect, the way will be open for U.S. assistance to Chinese nuclear power. It has yet to be submitted to Congress. At issue is whether the expected benefits to the United States from such assistance would outweigh potential drawbacks, and whether Congress should support or oppose the agreement.

Background

While the United States and its nuclear industry have assisted nuclear power use in many countries under agreements for nuclear cooperation, there has been no such cooperation with Sino-Soviet bloc states. The Soviet Union has successfully developed its own nuclear power technology independently. Until recently, China has shown little interest in nuclear power. However, over the past several years China has put together a program to develop and obtain a substantial amount of nuclear power for parts of that country which are far from its coal deposits. In April 1984, President Reagan, during his visit to China, witnessed the initialing of an agreement for nuclear cooperation with China. For the agreement to take effect, it must be submitted to Congress and lie there for 60 days. During that time Congress could disapprove it by legislation, assuming it could override a probable presidential veto of such an Act. Through the end of 1984, the Reagan Administration had not submitted the agreement to Congress, and it is not clear when, if at all, the agreement may be submitted.

If the agreement resembles those of the United States with other countries, it would provide a framework for general U.S. assistance to China's efforts to develop nuclear power. China needs such assistance because it wishes to become able to design and make its own nuclear power plants rather than to import them. The assistance could take several forms including: opportunities for China to send students and engineers to the United States for training in nuclear power technologies and to take part in nuclear development at various universities, industrial laboratories, and perhaps some DOE laboratories; opportunities to contract with U.S. nuclear firms for technical assistance to the Chinese nuclear power development; and opportunities to buy United States nuclear equipment and materials for the Chinese nuclear power program.

It is understood that the Chinese nuclear establishment prefers U.S. light water reactor technology and experience, although it could get competent assistance from West Germany, France, and Japan.

Analysis

U.S. assistance to Chinese nuclear power clearly would benefit China by improving the design and performance of China's homemade reactors and upgrading the general level of technological competence of its nuclear industrial base. Such assistance could also be important to some U.S. nuclear companies that urgently need new work, and could bring the benefits of fresh viewpoints to U.S. nuclear research centers. On the other hand, some would view with suspicion opportunities for Communist China to place more of its students and engineers in U.S. universities and in nuclear research centers.

United States nuclear power usually is so open and uncompartmentalized that Chinese here ostensibly for training or assistance with nuclear power could have access to many other technologies. Also, U.S. assistance which upgrades the general level of Chinese competence in nuclear power technologies would indirectly strengthen China's nuclear weapons capability and perhaps help them to improve the design and performance of their nuclear submarines.

Aside from benefits to China or the United States, there are also doubts in some quarters about the wisdom of U.S.-Chinese nuclear cooperation because of reports in the press that China has helped Pakistan with its nuclear weapons ambitions. Denials of these reports have had little effect.

ELECTROMAGNETIC PULSE (EMP)

Issue

A large nuclear explosion high above the United States would produce an electromagnetic pulse (EMP) that could destroy unprotected electronic equipment throughout the Nation. At issue is the vulnerability of civilian as well as military systems to EMP, and the adequacy of efforts to protect against the EMP threat.

Background

A high-altitude nuclear explosion produces electrons that are caught by the Earth's magnetic field which converts their energy into radio waves. The result is a microsecond burst of intense, broad frequency radio wave energy, which is one form of an electromagnetic pulse or EMP. EMP does not directly threaten living things, but it can disrupt or destroy any unprotected solid state electronics, including those used in radio and television broadcasting and receiving equipment; telephone equipment; computers; electric power production and distribution systems; and instrumentation and control systems in most electronic machinery and appliances.

It is relatively straightforward to shield or otherwise protect systems against high-altitude EMP. In some cases, shielding against normal electronic interference or lightning may suffice. However, EMP could be many times more powerful than lightning, and unless equipment has been specifically designed and tested to withstand EMP, its protection is doubtful. In addition, even carefully designed protective measures are not foolproof.

A primary concern is the threat posed by EMP to the strategic response capabilities of the United States. The Defense Department has major on-going programs to protect key sytems against EMP. However, considerably less attention has been given to the threat posed by EMP to civilian systems. As yet the EMP threat to civilian systems has not been clearly defined. The survivability of some civilian systems may not be of major concern if the Nation were under nuclear attack. On the other hand, electric power and civilian telecommunications systems are of obvious importance in minimizing public panic, and they have military significance as well. In addition, there may be scenarios far short of a full-scale nuclear exchange in which an adversary or even some U.S. defensive systems under consideration might generate an EMP signal above the United States.

Analysis

Questions the Committee may wish to consider regarding the EMP threat include: What civilian systems, in addition to electric power and telecommunication systems, need to be protected against EMP? What are the EMP scenarios of concern? Are private sector efforts to identify vulnerabilities and to protect systems against EMP adequate? What should the Government do to ensure that electric power, telecommunication, and other key civilian systems are protected against EMP? Do Federal, State, and local disaster planning efforts adequately consider the potential impacts of EMP? Is additional research needed on the nature of the EMP threat or on methods of protecting equipment? And should some classified research on protecting military systems against EMP be declassified and Defense Department EMP test facilities be made available to the private sector?

6. ENVIRONMENTAL R&D

See also items:

3.4 ENVIRONMENTAL ASPECTS OF PEST RESISTANCE

10.7 GLOBAL ENVIRONMENTAL AND NATURAL RESOURCES MONITORING

FEDERAL R&D, COAL, AND ACID PRECIPITATION

Issue

The appropriate role of the Federal Government in researching, developing, and demonstrating new coal-burning technologies is an issue given impetus by the current acid precipitation controversy.

Background

Although circumstantial evidence linking sulfur and other pollutant emissions from existing sources with adverse effects is convincing increasing numbers of scientists and policymakers that acid precipitation is a real problem, there is little agreement on precise causes, the seriousness of effects, the efficacy of current control options, and the consequences of alternative proposals for control programs. These uncertainties have led to a current program of research on acid rain causes and effects, and the implicit decision to wait before deciding whether to retrofit existing sources--major new sources must already meet stringent abatement requirements.

Putting off the decision extends the status quo, leaving open the question of the extent to which existing facilities will be refurbished without retrofitted controls, instead of being retrofitted or replaced by cleaner new facilities. It also provides time which could be used to investigate technological alternatives to existing ones.

Analysis

A number of new technologies for burning coal more cleanly and/or more efficiently show promise. They offer possibilities of reducing costs of controlling pollutants believed to cause acid precipitation and of increasing the efficiency of coal-fired electric generating facilities, as compared to conventional technologies.

Without substantial Federal support, however, many doubt that these promising new technologies will be commercially proven in time to affect decisions on constructing new coal-burning facilities that will be made in the near term. Recognizing this concern in H. Res. 648, the 98th Congress set aside funds for a "Clean Coal Technology Reserve," at a level of $750 million. However, legislative guidance as to the application of these funds may be sought.

EFFECTS OF ACID DEPOSITION AND OTHER AIR POLLUTANTS ON FORESTS

Issue

Some forests in various parts of the world, including the United States, are showing signs of decling productivity. A definitive cause-effect link for this decline has not yet been established. Scientific research, however, has engendered considerable debate about the role of acid rain, and other air pollutants, in forest decline. This debate is a source of controversy in congressional deliberations on whether to legislate emissions controls to reduce certain pollutants, particularly sulfur dioxides, believed by many to be precursors of acid deposition.

Background

Several countries in central Europe and Scandinavia have reported widespread forest damage, decline, and tree mortality. The problem appears to be most severe in West Germany where 34 percent of the forests surveyed have been reported as declining, dying, or dead. While the problem is of minor proportions in the United States as compared to West Germany, a decline in forest productivity has been documented for red spruce, ponderosa pine, and other species, primarily in the Appalachian Mountain Range, but in California as well. This may point to more widespread problems in coming years.

Despite considerable research effort world-wide, a cause-effect relationship has not yet been established to explain the demise of these forests. Many hypotheses have been proposed, although no agreement has been reached within the scientific community. Public perception has brought acid deposition to the forefront of the forest damage debates, but acid deposition is one of many possible culprits. Existing research points to photochemical oxidants (particularly ozone derived from nitrogen oxides) and trace metals (especially heavy metals) as other air pollutants directly affecting forest vegetation, and indirectly affecting the entire ecosystem through the soils.

Many observers advocate postponing costly emission control legislation until a definitive explanation of forest damage is proved and agreement exists in the scientific community. Others maintain that the West German experience should be an early warning to the United States and that enough legitimate research and circumstantial evidence exists to enact emission control strategies.

Analysis

Results of West German research studies cannot be directly extrapolated to the United States because of differences in the forest ecosystems and atmospheric chemicals. West German pollution concentrations are much higher than those in the United States. Although research has not established a definitive cause-effect link to explain forest decline, research results to date indicate that, given large, continuing influxes of acidic deposition and/or air pollution, ecosystems may suffer severe and long-standing damage. With regard to forests, existing research also indicates a range of possible pollutants, alone or in combination with natural factors, as contributing to the instances of forest decline. This suggests that emission control legislation consider not only sulfur dioxide emissions, but also other air pollutants and precursors of acid deposition, particularly nitrogen oxides.

USES OF NUCLEAR WASTES FOR STERILIZATION AND PRESERVATION

Issue

Some of the radioactive products of nuclear fission may be beneficially used for several purposes. Such use might reduce the risk and cost associated with disposing of these materials as waste. At issue is whether and how the Government might encourage the beneficial uses of the fission by-products of nuclear power reactors, while ensuring that they are used in a safe manner.

Background

Many fission products have uses as radioactive tracers and for other purposes in medicine and scientific research. However, the major potential use envisaged for fission products is to irradiate food, medical products, or sewage sludge to kill bacteria and/or insects. Extensive use of irradiation of foodstuffs for disinfestation and preservation alone could provide a beneficial use for all the cesium (the most plentiful fission product) produced in all the reactors in the United States.

Irradiation has been used commercially in this country for medical sterilization, disinfestation of spices, and sterilization of foods for manned space missions. In addition, considerable research has been performed on irradiation for disinfestation and preservation of a wide variety of consumer foodstuffs. Irradiated foods do not retain any radioactivity and no harmful effects have been found at moderate radiation levels. However, critics of food irradiation are concerned that the health effects of "unique radiolytic products" (URPs), created in trace quantities in irradiated foods, are not well understood.

Despite the potential benefits of food irradiation, which include reducing the use of potentially more hazardous chemical fumigants and preservatives, stringent Food and Drug Administration regulations for approval and consumer resistance to use of irradiated foods have retarded commercial development. The Food and Drug Administration currently is conducting a rulemaking procedure that could greatly expand the use of irradiation in the food industry.

The Department of Energy, through its By-products Utilization Program, has demonstrated the potential of cesium as an irradiation source. However, there has been no coordinated governmental effort to promote food irradiation. During the 98th Congress, hearings were held on a bill to provide Federal assistance for the development and commercialization of food irradiation by establishing a Commission for Food Irradiation Treatment in the Department of Agriculture, but no action was taken on the legislation.

Analysis

Issues that must be resolved before large-scale commercial development of irradiation technology can occur include the economics of the technology, means of ensuring safety, licensing requirements, labeling requirements, availability of radioactive source material, facility design, alternative technologies, and the marketability of irradiated foods. The major question for the Congress is whether the Government should take an active role in resolving these issues.

ALTERNATIVES TO LAND DISPOSAL OF HAZARDOUS WASTE

Issue

About 255 million to 275 million metric tons (tonnes) of hazardous waste under Federal and State regulation are generated annually. Some States have stricter definitions for hazardous waste than the Federal program, which regulates about 40 million tonnes annually. Land disposal is used for as much as 80 percent of regulated waste, some of which may remain hazardous for years or centuries. The key policy issue is, can unnecessary risks and future cleanup costs be eliminated by limiting the use of land disposal and by making alternatives to it more attractive?

Background

Uncontrolled and careless disposal of industrial waste became a national concern in the mid- and late 1970s. This led Congress to enact the Resource Conservation and Recovery Act (RCRA) in 1976. In addition to mismanagement and indiscriminate dumping at waste sites, it became increasingly clear that even well-intentioned and currently accepted waste management practices, particularly the use of landfills, surface impoundments, and lagoons, might also constitute substantial threats to human health. These threats arise from the potential slow leakage of waste constituents or leachate through the soil and into ground water, which is a source of drinking water for many communities.

There currently exists some technology or combination of technologies capable of dealing with every hazardous industrial waste in a manner that eliminates the need for perpetual storage. These technologies include incineration and pyrolysis on land, ocean incineration, chemical treatment, physical treatment, biological treatment, stabilization/solidification, and land treatment. Other storage alternatives include deep-well injection and seabed emplacement.

Analysis

The amount of hazardous waste being generated annually is increasing at a rate of about three percent per year. Among the policy issues that Congress may wish to examine are: Is the existing health, environmental, and management information an adequate basis for an effective national hazardous waste control program? To what extent are currently generated hazardous wastes subject to regulation by Federal and State programs? Can the amount of hazardous waste that is generated be reduced, and does the Federal regulatory program provide incentives or disincentives for waste reduction? To what extent do Federal regulatory programs affect the use of alternatives to land disposal of hazardous waste? To what extent can risk assessment be used in the regulation and management of hazardous waste? How effectively is the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) addressing the problem of uncontrolled hazardous waste sites?

REEXAMINING ENERGY AND ENVIRONMENTAL POLICY AND RESEARCH

Issue

While concern over energy has lessened in recent years, problems may still remain. U.S. oil production is declining, the nuclear industry is at a standstill, and funds for conservation, renewable energy technologies, and synfuels have been cut. Studies have confirmed that acid rain and CO_2 may be serious barriers to the expanded use of coal. Concern is over whether Federal R&D and energy policy will be adequate to promote environmentally-sound energy sources that will meet the needs of future decades.

Background

Since the peak of concern over energy policy in the late 1970s, events have drawn attention to both the successes and possible drawbacks to a market-based energy policy. There are no longer shortages of petroleum and higher oil prices have encouraged conservation and shifts away from energy-intensive technologies. On the other hand, the market does not fully address national security or environmental concerns. The status of the U.S. energy industry is questionable with respect to these concerns.

U.S. oil and gas production have begun a decline that is probably irreversible, world oil and gas production is likely to decline early in the next century, and the great bulk of the world's oil reserves remain in the middle east. Nuclear power faces continued political and financial uncertainty. Since 1978, no new nuclear plants have been ordered and 80 plants have been canceled. Although some plants are still planned to be completed, the length of time for permitting and constructing a plant means that nuclear power cannot rapidly expand to provide more energy. Federal funds for both conservation and renewable energies have been cut repeatedly in recent years and are proposed to be cut again in FY86. While the United States has abundant coal resources, recent studies have confirmed that both acid rain and CO_2 may be significant barriers to the use of the coal.

Analysis

Experience in recent years has demonstrated interconnections between different forms of energy in the marketplace. Oil prices influence the viability of synfuels, conservation, and renewable technologies, and regulations to control acid rain would influence the financial attractiveness of nuclear power. Similarly, regulations designed to reduce the hazards of nuclear power may indirectly encourage the use of coal, which creates different hazards. It may be useful to reexamine energy and environmental policies, considering the connections and trade-offs between different energy sources and environmental hazards. Opportunities may exist for inquiry into the adequacy of knowledge about energy-environmental interactions; interconnections between energy policy options; and the efficacy of policies designed to encourage the use of specific energy sources. Other areas for study may be the adequacy of research into CO_2 and acid rain, research on energy technologies that are benign with respect to acid rain and CO_2, and research on technologies to mitigate the effects of acid rain and CO_2.

MITIGATING ACID RAIN WITH TECHNOLOGY: APPLICATION OF FOREIGN TECHNOLOGY TO CONTROL SO_2 AND NOx EMISSIONS

Issue

Growing concern about the potential impact of acid rain has placed a new emphasis on the development of new, more efficient control technologies for use on electric generating and industrial facilities. Although the primary focus has been the Federal and private research effort in this country, significant experience exists in other countries, particularly Japan, in developing and operating control technologies. The issue, therefore, is the degree to which this experience and research is applicable to proposed acid rain legislation in this country.

Background

Acid rain is believed to be caused by the reaction of sulfur dioxide (SO_2) and oxides of nitrogen (NOx) with water vapor. The sources of precursors to acid rain include utilities, industrial facilities, and automobiles. Legislation has been proposed to significantly reduce these emissions, primarily from utilities.

Such emissions can be controlled technologically either prior to combustion (such as coal cleaning), during combustion (such as limestone injection multi-stage burners (LIMB), or after combustion (such as flue-gas desulfurization (FGD)). At the current time, only post-combustion devices, such as FGD, are capable of achieving the 70 percent plus reduction some high-sulfur coal-burning States would have to achieve under proposed legislation.

Japan has been the primary foreign country which has focused on achieving high rates of SO_2 and NOx reduction through post-combustion devices. Some of these devices, such as the Mitsubishi Heavy Industries (MHI) limestone FGD, are already being sold and operated in the United States. In recent years, Japan has focused on post-combustion NOx devices and simultaneous SO_2 and NOx reduction devices. While some of these devices are currently used in Japan, none are operating in the United States.

Analysis

Although some of these advanced technologies hold promise for significant reductions in SO_2 and NOx emissions in the United States, there are some questions. First, Japan is primarily an oil-burning country and, therefore, its technology is developed to operate on oil-fired facilities. The United States, however, is primarily concerned with emissions from coal-fired facilities. This may present technical problems for some Japanese technologies involving impurities in the gas stream, stream temperature, and other combustion-related differences between oil and coal combustion. Further research on coal-fired facilities may be necessary to commercialize such oil-fired-based technology.

Second, some of these technologies, such as post-combustion NOx reduction methods, use ammonia as a reagent. In an impure gas stream, some undersirable by-products may be produced. More research may be necessary on the environmental impact of such technologies.

7. ENVIRONMENTAL HEALTH R&D

See also item:

8.4 HEALTH RISKS OF ANTIBIOTIC AND ESTROGEN GROWTH PROMOTERS IN MEAT PRODUCTION

AIR POLLUTION

Issue

Despite the measurable improvements in air quality in many areas around the United States, there continue to be concerns about the healthfulness of the air (especially in relation to toxic air pollutants, acid deposition, and indoor air quality) and about the procedures for assessing and controlling potential risks of air pollution.

Background

The major air pollution control law is the Clean Air Act (P.L. 91-604) enacted in 1970 and amended in 1974 and 1977. Poor air quality can damage the physical environment and can be injurious to vegetation, wildlife on land and in the water, and human health. While there have been areas of the United States where air quality has been improved, there continue to be concerns that current laws and regulations, or efforts to implement and/or enforce them, still allow less than healthful air quality.

While the Clean Air Act (CAA) still awaits reauthorization, there are at least five topics of significant concern: fundamental philosophies affecting the rate and magnitude of pollution control efforts; acid deposition; indoor air pollution; hazardous air pollutants; and total exposure methodology.

Analysis

Fundamental questions. The Clean Air Act (CAA) calls for an ample margin of safety in protecting human health from the deleterious effects of air pollution. There continue to be questions about what "an ample margin of safety" means in relation to the broad range of air pollutants and individuals' health, including: How much protection is required by the CAA? How certain must the scientific/medical information be concerning the links between adverse health effects and air pollutants? How should the costs of achieving healthful air be distributed?

Acid deposition. Regional and international disputes have focused on the need for and cost of sulfur and nitrogen emission reduction plans. Uncertainty continues concerning the human health effects of acid deposition.

Indoor air pollution. Most Americans spend 70 to 90 percent of their time indoors. Additionally, many pollutants are concentrated indoors. Yet the Clean Air Act remains silent on the issues of indoor air quality research and control.

Hazardous air pollutants. Section 112 of the Clean Air Act is designed to regulate hazardous air pollutants, such as vinyl chloride and asbestos. Since enactment, only seven substances have been listed by EPA for control; regulations have been issued for only four. Despite more restricted research resources, some States have begun their own regulatory programs, resulting in a sometimes inconsistent set of regulatory efforts across the Nation. There are at least two generally cited reasons for the glacial pace of EPA regulation: (1) The EPA maintains that it needs greater flexibility in implementing section 112. Specifically, the Agency would like to be able to incorporate a wider range of considerations (for example, economic impacts and coordination with extant State and local regulations) into its decisionmaking process than is currently allowed. (2) Many environmental groups maintain that the Agency needs more specific directions in order to fulfill the requirements of section 112 (for example, to require EPA to list automatically for regulation all hazardous air pollutants not determined to be nonhazardous).

Total exposure methodology. The assessment of risk is a necessary prerequisite to the management of risk. Concern exists over the completeness of EPA risk assessments, that is, whether all reasonable routes of potential exposure to risk are considered, such as inhalation of pollutants indoors and out, ingestion, and contact.

WATER POLLUTION AND WASTE DISPOSAL

Issue

Virtually every human activity generates some waste. At issue is how to dispose of these wastes without endangering human or environmental health, how to protect groundwater from these wastes, how to reclaim contaminated groundwater, and how to ensure delivery of safe drinking water.

Background

The Federal Water Pollution Control Act (P.L. 80-845) is the principal law protecting the Nation's waterways. It was enacted in 1948 and amended in 1972 (P.L. 92-500), 1977 (P.L. 95-217), and 1981 (P.L. 97-117). Protecting public drinking water systems is the Safe Drinking Water Act (P.L. 93-523), enacted in 1974. Despite these two acts, groundwater and drinking water have been contaminated in several places and at different times. These two acts alone, and in their present forms, have not been able to protect fully or reclaim the Nation's water resources.

Analysis

In manufacturing processes, in applying pesticides to (agricultural) produce, and in simply living, humans generate wastes which require disposal. Many of these wastes are hazardous chemicals, such as pesticide contaminants like dioxin, which were not truly disposed of in the past but were merely stored (in landfills or other accessible places in the environment) and are now coming back to plague those living around the sites, and those drawing water contaminated by the sites. The Toxic Substances Control Act (P.L. 94-469), the Resource Conservation and Recovery Act (P.L. 94-580), the Comprehensive Environmental Response, Compensation, and Liability Act (P.L. 96-510), and the Federal Insecticide, Fungicide, and Rodenticide Act (P.L. 92-516, as amended) are very important to efforts to protect or reclaim water resources.

Findings by the National Academy of Sciences, among others, strongly suggest that much more needs to be know about the nature of the vast majority of commercial chemicals in order to protect more fully human and environmental health. Such needed information includes knowing the environmental fate of chemicals (that is, where they go, how fast they move, and with what they interact), and knowing how to dispose of them safely and truly when they are no longer needed or useable. Legislative proposals have been made to encourage the development of true disposal technologies and facilities, especially for hazardous chemicals.

Hazardous chemicals stored in the environment have, in too many incidents, contaminated groundwater. Groundwater supplies, in whole or in part, the water demands of about 75 percent of the Nation's cities. About half of the U.S. population depends upon groundwater as the primary source of drinking water. The protection and reclamation of this important resource is clearly important. Debates have focused and will continue to focus on the need for uniform standards for groundwater quality, the need for monitoring of groundwater quality, and the need to research further the health effects of, and clean-up technologies for, contaminated groundwater.

Finally, contaminated groundwater, the deteriorating water supply infrastructure, acid deposition, pesticide residues, water recycling efforts, are all general concerns related to the quality of the Nation's drinking water. Particular concerns relate to the establishment of new standards for drinking water quality, monitoring for compliance with standards, determination and control of sources of contamination, and research and monitoring of health effects of low-quality drinking water.

PROTECTING HUMAN AND ENVIRONMENTAL HEALTH

Issue

A role of government is the protection of citizens from hazards they cannot reasonably control on their own. A necessary prerequisite to reasonable control is an understanding of the nature and magnitude of the potential hazards. Controversy exists over the adequacy and cost of the Government's fulfillment of its health protection role.

Background

Protection of human and environmental health cannot be performed entirely by ordinary citizens. Public opinion polls and significant increases in membership in environmental groups reflect the fact that the public favors stronger environmental programs more emphatically now than at any time since the early 1970s. Related concerns include the magnitude of funding levels for environmental health R&D; quality, quantity, and coordination of research; and use and nonuse of research results.

Analysis

Funding. Public funding of environmental health R&D is very expensive. The U.S. Environmental Protection Agency (EPA) alone has spent in excess of $200 million each year in recent years on this endeavor, and EPA is not the only Federal agency doing this kind of R&D. There is interest in, and there have been efforts to support, environmental health R&D by using both public and private sector funds. (An example of this is the Health Effects Institute, which studies the health effects of automotive emissions and draws half of its $6 million annual budget from EPA and half from the automotive industry.) Continuing concerns focus on ways to improve the cost efficiency and effectiveness of environmental health R&D funding; to decrease the magnitude of public expenditures on this endeavor; and to ensure the objectivity of R&D that is at least partially supported by private funds.

Quality of research. There continues to be concern that, despite finite resources, there be adequate monitoring of R&D efforts to protect against laboratory fraud. A recent case of fraud resulted in doubt being cast on the safety of 200 pesticides and on EPA's monitoring procedures.

Quantity of research. A National Academy of Sciences' study estimated that information sufficient to allow a complete health-hazard assessment to be made exists for less than two percent of the chemicals in commerce (about 1,340 out of about 67,000). Additionally, there is concern that there is little monitoring of chemicals in the environment and hence little information about the actual magnitude and duration of exposure to chemicals. The general concern is that there is currently an insufficient quantity of environmental health R&D.

Coordination of research. It has been argued that not only should more toxicity testing be done, but that such research, to maximize cost efficiency, needs to be better coordinated among the several Federal and private organizations performing the work, including the FDA, EPA, National Institute for Occupational Safety and Health, National Toxicology Program, National Institute for Environmental Health Sciences, Chemical Industry Institute for Toxicology, and the Health Effects Institute.

Use of research results. The assessment of risk is a necessary prerequisite to the management of risk. Concern exists over the completeness of risk assessments, that is, whether all reasonable routes of potential exposure to risk are considered, such as ingestion and inhalation, not just ingestion, of EDB. There is a related concern that all known information relevant to a policy decision be disclosed, not just the information supporting the decision, whether that decision is to regulate or not to regulate the chemical. The initial decision by EPA not to regulate formaldehyde under section 4(f) of TSCA, for example, was controversial partially because of EPA's methods of disclosing information relevant to the decision process.

8. FOOD AND NUTRITION RESEARCH

See also items:

3.1 PRIORITIES FOR AGRICULTURAL AND FOOD RESEARCH

6.3 USES OF NUCLEAR WASTES FOR STERILIZATION AND PRESERVATION

NUTRITION RESEARCH AND MONITORING

Issue

The relationship between diet and health disease as well as the nutritional status of the American people continue to be of concern to policymakers.

Background

Human nutrition research has been the primary responsibility of both the Department of Agriculture (USDA) and the Department of Health and Human Services (DHHS). Within DHHS, the National Institutes of Health, the Food and Drug Administration, and the Centers for Disease Control conduct the research. A number of other agencies carry out the Federal effort to a lesser extent. Along with the 1977 mandate as the lead agency for food and agriculture research, USDA was directed to coordinate research goals within the Department, and to coordinate goals and implementation with other agencies and departments of the Government which have responsibilities for food and nutrition research. The Food and Agriculture Act of 1977 specified that the Secretary establish research into food and human nutrition as a separate and distinct mission of USDA and requested an assessment of the potential for establishing regional food and nutrition centers for the development of additional human nutrition research programs. Several new centers were created, bringing to six the number of human nutrition centers operating under USDA's program. In 1983, the Grace Commission Report recommended transfer and otherwise reducing the role of USDA in human nutrition research programs involving human subjects.

Interest in the creation of a comprehensive, coordinated monitoring system grew out of evidence in the late 1960s and again in the early 1980s that the Government lacked data on hunger and nutrition problems in certain age, income, and geographic groups. Several reports published in the past two years have indicated that such a system would be necessary to generate the data needed by policymakers. The Food and Agriculture Act of 1977 required USDA and DHHS to develop and submit to Congress a joint proposal for a comprehensive nutrition status monitoring system. A number of delays have been experienced in meeting the projected 1987 implementation date for completion of the coordinated system. During the past three Congresses, the House Committee on Science and Technology held oversight hearings on nutrition research and the monitoring system. The latest hearing, on June 20, 1984, focused on H.R. 4684, the National Nutrition Monitoring and Related Research Act of 1984, a bill designed to establish a coordinated monitoring and research program to assess the nutritional and dietary status of the U.S. population and quality of the U.S. food supply. H.R. 4684 was considered by the full House, under suspension, but did not obtain the two-thirds majority required. A similar bill, S. 3022, was introduced in the Senate but no action was taken during the 98th Congress.

Analysis

The Committee may wish to assess the potential impact on nutrition research and monitoring activities of the comprehensive proposals to cut the Federal budget in the context the following issues: Is the lead agency designation for food and agriculture research still appropriate? Should those research activities, specified in the Grace Commission Report as appropriate to move to DHHS, be transferred? What is the best mechanism for coordination of a comprehensive nutrition monitoring system in order to be sure that the data collected are useful and timely for policymakers? Since funding uncertainties have been one of the causes for delay in the past in meeting the short term goals toward a 1987 implementation date of a coordinated nutrition monitoring system, what is the best way to fund this effort in a prospective manner so that agency officials can proceed with confidence that the moneys will be available as the system progresses in the future?

FOOD SAFETY POLICY AND ARTIFICIAL SWEETENERS

Issue

During the 98th Congress, several bills were introduced and hearings held concerning revision of the Federal Food, Drug, and Cosmetic Act. Support for statutory change has been gaining momentum since the 1970s when it was discovered that several artificial sweeteners caused cancer in laboratory animals. Proposed changes in the Act have largely focused on the choice between the zero tolerance standard of the Delaney clause and the use of risk assessment. Interest in the 99th Congress will likely focus on the Delaney standard and the risk assessment debate.

Background

In 1938 the Federal Food, Drug, and Cosmetic Act (FDCA) became law, clarifying circumstances under which a food is considered adulterated or misbranded, and thus subject to FDA action. Several amendments designed to prevent, where possible, harmful substances from being allowed into the food supply were added to the Act in the 1950s and 1960s. Specific provision was made to ban the use of any food or color additive or animal drug demonstrated to cause cancer (irrespective of dose) in man or animal. This provision is commonly referred to as the Delaney clause.

In recent years, FDA has banned the use of several previously approved food additives, including an artificial sweetener, on the grounds that these substances may have negative health effects. One example is cyclamate, the primary artificial sweetener in use during the 1950s and 1960s. In 1969 FDA banned the use of cyclamate from food, beverages, and drugs after animal studies revealed that this sweetener may cause bladder cancer in animals. Since 1969 FDA has received numerous petitions to reverse this decision, and the agency is currently reexamining whether to reverse the ban.

Saccharin was the only non-nutritive sweetener on the market from 1970 to 1981. In 1977 FDA proposed a ban on saccharin after animal studies indicated that it too may cause bladder cancer in animals. This proposed ban, however, was overruled by Congress following a strong public demand for an artificial sweetener to be available on the market. The initial moratorium against such a ban imposed by Congress in November 1977 has been extended several times and will expire again in April 1985. Despite the consensus that saccharin is a weak carcinogen, each time Congress has extended the moratorium under the rationale that there was no other artificial sweetener on the market. However, in 1981 FDA approved the use of aspartame, an artificial sweetener composed of two amino acids, which is now being incorporated into the manufacture of many processed foods and beverages. The most recent studies of saccharin have only continued to confirm its carcinogenic potential, and the controversy on whether it ought to be banned.

Analysis

At the time the anticancer clause was added to FDCA, there was a scientific consensus that there existed no safe level of exposure to a cancer-causing substance. There is now considerable disagreement over that assumption. Any amendment of the Delaney clause would involve a determination by Congress that there is a level of risk that society should be willing to accept from food products. In addition, such an amendment would draw attention to the uncertainties involved in doing risk assessment. Any debate on this subject is likely to include a discussion of administrative interpretation of the use of risk assessment and the role of Government to protect and inform the public of potential risks. With the current reevaluation of cyclamate, the upcoming expiration of the saccharin moratorium, and lingering questions about the safety of aspartame, these three artificial sweeteners are likely to be the focus of the debate as the larger generic questions concerning the Delaney clause and other food safety provisions are examined.

REGULATION OF DIETARY CARCINOGENS

Issue

During the 98th Congress, hearings were held and bills introduced which concerned the appropriateness of the zero-risk standard tolerated for food carcinogens that are subject to the Delaney clause of the Food, Drug, and Cosmetic Act. An alternative standard has been proposed which would permit "negligible risk" to human health from dietary carcinogens. The risk level would be determined by risk assessment based on the potency and dose of the carcinogen, factors which cannot be considered under the zero-risk Delaney standard. Interest in risk assessment as an alternative to the Delaney standard will likely continue during the 99th Congress.

Background

The Delaney clause of the Food, Drug, and Cosmetic Act is used to regulate food and color additives and animal drug residues in meat which are found to be carcinogenic, by appropriate tests, to animals or humans. Because the standard forbids approval of carcinogens, regardless of potency and dose of the substance, it is considered a "zero-risk" standard. The Delaney amendment to the Food, Drug, and Cosmetic Act was enacted in 1958, when there was a scientific consensus that relatively few carcinogens existed and that it was possible to avoid exposure to them. As technological advances have led to detection of increasingly smaller amounts of food carcinogens, and the list of known carcinogens has grown, the consensus has dissolved.

While substantial support for the Delaney standard still exists, support for a standard which would allow "negligible" or "de minimis" risk, as measured by risk assessment calculations, also has significant support. Individuals favoring continued use of the zero-risk standard argue that risk assessment methodologies are still too crude and subject to manipulation and bias to reliably predict cancer risks. People who support the negligible risk standard indicate that, while there are problems with risk assessment methodologies, it is the best alternative available, and one that should be used because of the increasing difficulty experienced in applying the Delaney standard.

Analysis

Issues which have emerged as a result of the Delaney/risk assessment debate have centered on the benefits and detriments of each standard. Debate continues on whether or not the Delaney standard provides a greater level of health protection than risk assessment would, or if it only focuses inordinate attention and resources on trivial risks. Controversy continues to surround the adequacy of risk assessment to predict what substances pose a negligible risk. Concern has been expressed that the assumptions made in a risk assessment influence the outcome and leave the process open to political or other manipulation. In addition, the ability of risk assessment to account for cumulative risks posed by exposure to many real carcinogens has been questioned. The 99th Congress may wish to consider these issues.

HEALTH RISKS OF ANTIBIOTIC AND ESTROGEN GROWTH PROMOTERS IN MEAT PRODUCTION

Issue

During the past decade, Congress has demonstrated continued interest in the safety of the meat supply. The use of animal drugs, particularly subtherapeutic antibiotic drugs and estrogen hormones to promote growth of meat-producing animals, gained attention in the late 1970s and again in the 98th Congress. In 1977, Congress blocked restrictions on subtherapeutic antibiotic use proposed by the Food and Drug Administration (FDA), pending further research. In 1979, the estrogen, diethylstilbesterol (DES), was banned by FDA for use as a growth-promoting agent. Recently, congressional interest in antibiotics and estrogens was rekindled by scientific reports suggesting associated health hazards. The adequacy of regulations governing use of these animal drugs will continue to be of interest to policymakers, consumers, and food producers.

Background

Subtherapeutic (low-level) antibiotics and estrogen hormones routinely are used to enhance the growth of meat animals. The use of antibiotics for growth promotion has climbed steadily since 1950 and, together with other minor use, accounted for 48 percent of U.S.-produced antibiotics in 1978. Subtherapeutic antibiotic use is controversial because of the tendency for antibiotic-resistant bacteria to grow in environments where antibiotics are present. Because resistance genes can be passed between different bacterial varieties, microbes can become resistant to several different antibiotics. Infection by resistant bacteria can be difficult or impossible to treat if an antibiotic cannot be found to which the organism is susceptible. Whether or not subtherapeutic antibiotics are a real or only theoretical danger to human health is a continuing concern. If such use is a danger, it is unclear if banning the practice would decrease antibiotic resistance in the bacterial population. Following the 1968 ban of subtherapeutic antibiotics in Great Britain, the FDA began to reevaluate U.S. policy. In 1977, FDA proposed a ban on subtherapeutic penicillin and restrictions on tetracyclines, drugs important for human therapy. Upon congressional mandate, further regulatory action was held in abeyance until research recommended by the National Academy of Sciences (NAS) could be completed. FDA is currently reviewing the completed NAS studies and other research. Following this review, FDA will announce plans for regulatory action, if any.

Several estrogen hormones are available for growth promotion in meat animals. These include zeranol and estradiol derivatives. Diethylstilbesterol is available for therapeutic use only. Interest in estrogen animal drugs recently reemerged when a scientific study linked a high incidence of premature puberty in Puerto Rican children with possible environmental estrogen contamination. The Center for Disease Control, FDA, and the Department of Agriculture are investigating the situation, but so far have been unable to identify a source of contamination by estrogen.

Analysis

Issues regarding the adequacy of animal drug regulation have emerged because of specific interest in antibiotics and estrogens. FDA sets standards for drug use; USDA monitors drug residues in meat. This system monitors antibiotic residues, but in no way measures potential risks posed by resistant bacteria. Standards for estrogen use have been established, but residues are not routinely tested for by USDA. In addition, more general concern has been raised about the effectiveness of enforcement of drug use regulations. The opportunity for abuse of animal drugs results because most veterinary drugs are available on an over-the-counter basis, a black market for illegal animal drugs is operating, and drugs prescribed and dispensed by veterinarians are not routinely documented and cannot, therefore, be monitored. In addition, differences in international animal drug laws have contributed to problems with meat importation and the availability of black market drugs in the United States. In the case of antibiotic use, international consistency is great if there is truly a significant health risk associated with subtherapeutic antibiotic use, since resistant bacteria easily travel across geographic borders.

During the 99th Congress, policymakers may wish to examine whether existing animal drug regulations are adequate to protect public health.

THE POTENTIAL FOR INCREASED USE OF FOOD IRRADIATION TECHNOLOGY

Issue

Despite 40 years of research, the practical application of food irradiation as a means of food preservation has not been realized in the United States. Yet the use of ionizing radiation to protect food may serve as an important alternative or appropriate adjunct to the current use of pesticides, many of which may have restriction on their use in the future. Some modification in existing law may be required.

Background

Although the phrase "irradiation of food" can refer to the treatment of food by several types of radiation processes, recent interest has focused on the process of using ionizing radiation to preserve food. Food can be preserved by this method through the destruction of larval and adult forms of insects as well as the destruction of microorganisms which are involved in food spoilage. The focus of the safety questions for this processing method is concerned with reliance on state-of-the-art toxicology testing of the chemical products formed by the irradiation process. The phrase "sources of radiation" is included in the definition of a food additive, requiring that the effect of radiation of food must be shown to be safe. It has been the "additive" status of the irradiation process which has led to difficulties in testing the safety and wholesomeness of irradiation products. Despite approved uses of irradiation for sprout inhibition of potatoes and disinfestation of wheat flour, these applications have not been used commercially.

A number of international scientific organizations have issued reports examining the wholesomeness of irradiated food. A 1981 joint report of several international organizations recommends unconditional clearence of any food irradiated up to an overall average dose of 1,000 kilorads. This dose level is ten times greater than that proposed by FDA. Currently, a number of countries have given clearance to the use of irradiation for at least one food item. World-wide acceptance of this process will be hindered until the developed nations not only approve the use of food irradiation, but have applied the method commercially to a wide variety of commodities. Estimates are that the world's total food supply could be increased by 25 to 30 percent if post-harvest losses could be avoided, and irradiation of food is one method which could decrease post-harvest losses.

If FDA finalizes its 1984 proposed rules for the food irradiation process at doses at or below 100 kilorads, several potential applications of the process could become viable, including disinfestation for fresh fruits and quarantine purposes; disinfestation of vegetables, dried fruits, beans, and cereals; elimination of Trichinella spiralis from fresh pork; and control of insect infestation. None of these applications are currently at the point of commercial development within the United States.

Analysis

The Committee may wish to assess the potential impacts of this food processing method in the context of research needs and policy changes, such as the following, necessary to use the technique on a routine basis: What research programs might be funded to examine the potential for elimination and/or reduction of the use of pesticides in the post-harvest stage of commodities, if irradiation is used? What is the status of the toxicological testing data available on the safety of the process? What more is needed? Is the FDA proposal to approve irradiation processing at the 100 kilorad level appropriate or should the 1,000 kilorad level approved by international agreement be given consideration by the U.S. Government? Should food irradiation continue to be regulated as a food additive or should the technique be regulated as a process? Should the labeling on irradiated food state that the process has been used? What is the availability of the radioactive materials used in the process and how will this affect the routine use of the technique? What are the likely costs of irradiating foods, and how does this compare to current processing costs?

9. INFORMATION, COMPUTERS, AND TELECOMMUNICATIONS

FEDERAL INFORMATION POLICY FORMULATION

Issue

Advances in data processing and telecommunications technologies create new opportunities for efficient information transfer, make possible a proliferation of new products and services, and provide improved information support for decisionmakers. As the economy becomes more service oriented, there is a concommitant increase in the reliance on information and the value attached to it. This transformation in society raises substantial new public policy issues. Various groups are concerned that the United States can no longer afford to address these issues in a piecemeal fashion and that this Nation must have coherent and coordinated information and telecommunications policies if it expects to compete effectively with its major trading partners. Others contend that the diversity of policy perspectives provides the best approach.

Background

The transition to an information-based society in recent years has focused attention on the importance of computer and telecommunications technologies in all aspects of society. In addition, the world-wide leadership of the United States in computer and telecommunications technologies has been increasingly challenged by Europe and Japan. These developments have prompted a new look at policymaking activities in the United States Government.

During the last few Congresses, legislation has been introduced to restructure executive branch responsibilities for information policy formulation, and hearings have been held on the topic. While some of the legislation has been aimed at international information policy responsibilities, other bills have encompassed the domestic information policy arena as well. Recent proposals for a Department of International Trade and Industry and a Department of Science and Technology would affect how information policy is developed in the Federal Government as well.

Analysis

Information and telecommunications issues are addressed in virtually every agency and department of the Federal Government. Although there are several key players responsible for formulating and coordinating information policies, no single authority exists and established coordination mechanisms have not always been successful. A number of interests see the need to delineate more precisely responsibilities for information policymaking, increase resources, elevate issues to a higher level of authority, and improve coordination among agencies and between the public and private sectors. Some advocates propose creation of a centralized authority as a means of improving the policymaking process, while others recommend the establishment of better coordinating mechanisms.

On the other hand, there is opposition to centralizing information policy formulation. Opponents are concerned that an issue which permeates so many governmental activities should be handled within the operational settings of the mission agencies. Another difficulty they cite is defining the scope of information policy. Finally, they see the pluralistic approach as valuable for ensuring that a diversity of viewpoints is represented.

ACCESS TO FOREIGN SCIENTIFIC AND TECHNICAL INFORMATION

Issue

Timely access to foreign scientific and technical information (STI) is vital to U.S. competitiveness in high technology products. During 1984, congressional hearings were held on the availability of Japanese STI in the United States. In addition, legislation was introduced which proposed funding to increase access to this literature. Congress continues to remain concerned about the appropriate Federal role in acquiring, coordinating, and disseminating not only Japanese STI, but also foreign STI in general.

Background

Foreign industrialized nations increasingly are viewing advances in science and technology as critical to their economic growth and productivity. Targeted national projects in areas such as computers, semiconductors, fiber optics, and biotechnology highlight the importance that foreign nations attach to the development of high technology products for future competitiveness in world markets. This trend is particularly evident in the growth of research and development expenditures, which in turn have stimulated a significant increase in the amount of scientific and technical literature.

Given this situation, some observers believe that the United States needs to monitor foreign developments in science and technology and to acquire related literature to remain competitive. They believe that the United States can no longer afford to neglect foreign competition in high technology fields. In addition, the rapid changes occurring in many fields of science and technology, as well as the rising costs of R&D, would make it increasingly difficult in the future for the United States to be technologically self-sufficient.

Analysis

Although several Federal agencies have programs to acquire, translate, and disseminate foreign STI, these efforts primarily support agency needs and are uncoordinated. Private abstracting and indexing firms appear to have engaged in the most systematic attempt to acquire these foreign data. These services, however, frequently are neither timely nor comprehensive. In addition, while some companies track foreign developments in science and technology, it is generally the larger corporations which can afford these efforts, thus placing smaller firms at a competitive disadvantage.

The policy debate concerning access to foreign STI focuses on whether the Federal Government needs to assume a greater role in this area. Proponents claim that there is a need for more rapid access to foreign STI and that the Government should assume a greater role to overcome existing barriers, such as the shortage of competent, technical translators in certain languages. On the other hand, it can be argued that the need for greater access to this literature has not been demonstrated. Further, if the demand exists, one can argue that private companies should respond to the need in classic market fashion.

Congress may want to continue monitoring the needs of U.S. researchers and companies as well as the efforts of Federal agencies to determine if a greater Government role is required in accessing foreign STI. In addition, Congress may be interested in tracking recent developments---such as machine translation and plans for automated international exchange of patent data--- to assess their impact on the issues associated with U.S. access to foreign STI.

RESTRICITONS ON TRANSBORDER INFORMATION FLOWS

Issue

The rapid development of computer systems and telecommunications networks provides increased efficiency in transferring information on a global basis. At the same time, barriers have been erected by several countries to regulate the transmission of data across national boundaries and impede the free flow of information world-wide. These events have raised questions about how the United States can best promote U.S. interests abroad and establish effective policies for countering foreign restrictions on transborder information flows which inhibit commerce.

Background

Many countries are increasingly concerned about the growing amount of data--personal data about individuals, commercial information, and national economic data--being processed and stored in computer systems outside their countries. Several nations have responded by erecting barriers--both tariff and nontarriff--to the flow of information and have developed national strategies for information and telecommunications development. Many of these barriers represent economic concerns, including the support of domestic data processing and telecommunications industries. However, others reflect such social and political concerns as personal privacy and national security and sovereignty.

The effect of these barriers on international information flow is only beginning to be realized. Substantial damage may be done to individual firms, to the U.S. economy, to world commerce, and to principles of the free flow of information. Congress has focused on the need for the United States to take positive steps to respond to the efforts of foreign nations and multinational organizations to restrict transborder information flows. How the United States can best establish effective policies which represent the interests of both U.S. enterprises and the Nation at large remains of concern to Congress.

Analysis

A variety of approaches have been suggested for improving the ability of the United States to effectively respond to challenges to transborder information flows. One approach being considered is to improve U.S. Government policy formulation by altering the current structure in the executive branch. Another has been to strengthen Section 301 of the Trade Act of 1974 (P.L. 93-618, 19 USC 2411) to give the President broader powers to respond to unfair trading practices in other countries. Congress may wish to consider whether further actions may be required to protect U.S. industries from foreign barriers to the flow of information.

INFORMATION TECHNOLOGY IN HEALTH AND MEDICAL SCIENCES

Issue

Information technology may be very beneficial to the maintenance of health over the long term, but it is likely to be rather costly in the beginning. Further, in order for information technology to be truly effective in the health and medical sciences, its implications for social equity, personal privacy, and problems of achieving reliability will need to be considered.

Background

Over the last 15 years, medical and health sciences have provided both physician and patient with dramatic new diagnostic and therapeutic tools. Computers, telecommunications networks, and intelligent, microprocessor-based medical equipment have been increasingly applied to health problems and situations. Intensive-care monitors, computerized axial tomography (CAT), automated laboratory instrumentation, and the MEDLARS information system are familiar examples. The medical and health industry no longer borrows applications of information technology from other disciplines; rather, it is now innovative in its own right. These applications include: computer-aided diagnosis, computer-aided treatment, information technology for adjunct functions to direct diagnosis and treatment, mental health, and illness prevention.

Analysis

There are a number of general limitations and policy-related considerations pertaining to the use of information technology for health and medical purposes. Various and creative applications have been a factor in the improvement of life expectancy and quality of life in the United States. However, information technology has been employed within a health-care system slow to change its structure and such technology has become a significant element in the growth of medical costs. Because of health care insurance, or third-party payments, there has been little restriction on the costs of technological advances and there has been rapid diffusion of medical information technology. Further, a powerful incentive to such diffusion is the fact that information technology is beginning to produce substantial income for physicians and hospitals. Because information technology can be rather costly in the initial applications, vertical, horizontal, and temporal equity of access also has to be considered. Vertical equity of access pertains to the degree of access afforded to persons in different socioeconomic strata; horizontal equity of access relates to the degree of access afforded to people in the same socioeconomic strata, but living in different geographical locations, such as rural and urban; temporal equity of access concerns the degree of access granted to persons at different times of their life cycle, such as for children and elderly persons. How to provide equity of access to the developing information technology in medical care for the aforementioned conditions is a possible policy consideration.

Another issue is privacy, which arises when considering any system which gathers, stores, manipulates, displays, and communicates personal data. Having medical histories, billing and payment transactions, as well as the record of actions of attending health professionals all in one place, instantly accessible, raises concerns about personal privacy rights and fears of unauthorized and unreasonable access to data. Similarly, the rights of health professionals to practice the medical arts and sciences as they see fit can be threatened by a system of computer-based monitoring. Finally, there is the issue of reliability or the capacity of information technology to provide the expected function under all conditions--atypical as well as typical--for all kinds of patients. The reliability of information technology guided by both technical and human decisions raises issues of negligence and liability which Congress may wish to address.

SUPERCOMPUTERS AND ARTIFICIAL INTELLIGENCE

Issue

In 1983 and 1984, Congress approved legislation which provided appropriations for several new initiatives in two areas of leading-edge computer technology--supercomputers and artificial intelligence (AI). The debate focuses on whether the Government is supplying adequate funding for projects that could be considered high risk by the private sector and whether the new programs are being executed in a coordinated and efficient manner. In addition, challenges from international competitors, such as Japan and the United Kingdom, continue to raise issues over whether these new initiatives are sufficient to ensure continued U.S. leadership in superspeed computing and AI.

Background

Supercomputers can be thought of as the fastest computers at any given time. These high-speed "number crunchers" are used for modeling or simulating a variety of scientific and engineering problems. Technological advances to produce the next generation of supercomputers are expected to supply some of the essential elements needed to develop artificial intelligence computers or computers that can imitate human reasoning and thinking. To date, AI has had success only in the form of "expert" or knowledge-based systems which give advice and make decisions in specific subject areas.

Supercomputers historically have played a critical role in scientific and engineering advances. Many experts contend, however, that for further advances to be made, increased research and development and access to supercomputers will be necessary. During the 98th Congress, the Federal role in supercomputers and AI expanded significantly when Congress appropriated funds for the following projects: the Defense Advanced Research Projects Agency's (DARPA) new Strategic Computing Program in artificial intelligence; the National Aeronautics and Space Administration's project to build a higher-level supercomputer known as the numerical aerodynamic simulator; the National Science Foundation's Advanced Scientific Computing Program to increase access for researchers to supercomputers and to establish new supercomputer centers; and the Department of Energy's program to expand access to supercomputers for energy research scientists.

Analysis

Congress has responded to concerns over the possible loss of U.S. leadership in supercomputers and AI by funding these new initiatives. Consequently, the focus of the debate has expanded. Initially, the policy debate concerned whether the Government needed to assume a larger role in efforts to extend the limits of existing technology. Today, the debate includes questions on how these programs are being administered and whether the structure and objectives of the projects are workable.

In particular, DARPA's Strategic Computing Initiatives--the program which, to date, has received the largest portion of total funding--has been challenged in recent months. Critics have questioned the military focus of the program as well as the feasibility of attaining the stated goals. In addition, the program reportedly has fallen behind schedule. On the other hand, supporters of the program claim that the project will ensure U.S. dominance not only in future information processing areas, but in gaining access to new commercial markets. Considering the importance of supercomputer and AI technologies to the U.S. economy and national security, Congress may want to examine these new initiatives to ensure that they best serve the needs of the Nation.

COMPUTERS IN EDUCATION

Issue

During 1983 and 1984, Congress considered legislation that addressed issues associated with the need for Federal intervention in the area of computers in education. One bill that was enacted--H.R. 1310 (P.L. 98-377), on mathematics and science education--contained funding for programs that included computer learning as a focus. Other bills reported by committees focused on issues such as incentives for developers of educational software. With the growing use of computers in the classroom, Congress remains concerned about the appropriate role of Government in this area.

Background

Microcomputers are appearing in the Nation's classrooms at an ever-increasing rate. In June 1982, the number of computers in public schools was 125,000; by June 1984, this figure had increased to 630,000. One expert estimated that, in 1981, there was one computer for every 913 students. Currently there is approximately one computer for every 72 students. If this trend continues, in five years there will be one computer for every 14 students.

The introduction of computers into the classroom frequently has not been accompanied by adequate planning and curricula readjustment. In many cases, schools purchase microcomputer hardware and then encounter difficulties in locating suitable software. In addition, teachers generally do not receive sufficient training about computers and their potential advantages and misapplications in teaching.

As a result, some experts claim that schools are not utilizing the full potential of computers to teach subjects in a more effective manner. Instead, educators are using computers for computer literacy, or teaching about the computers themselves, and for routine tasks such as drill and practice exercises. According to a study by the Center for the Social Organization of Schools at Johns Hopkins University, nearly two-thirds of student computer time in high schools two years ago was devoted to computer literacy, 18 percent was spent on drill and practice, and the remainder on electronic games, word processing, and data retrieval uses. At the elementary-school level, the study found that students used computers for drill and practice for 40 percent of computer time, followed by computer literacy for 36 percent and games for 24 percent.

Analysis

As the number of computers in U.S. public schools has increased, the debate over their advantages and disadvantages as well as their use has intensified. Proponents of computers in education maintain that computers, when properly utilized, can serve as valuable resources for both teachers and students. In a time of educational funding cuts, computers are viewed as tools for improving the effectiveness and productivity of the educational system. Advocates cite a variety of benefits, including individualized instruction and the enhancement of the teacher's role by freeing them from routine tasks, such as drill and practice. In addition, educators can integrate computers with telecommunications to provide services to remote communities and special populations.

Critics of computers in education contend that there are problems associated with the increased use of computers in schools. One of the major problems is the difficulty in selecting quality educational software. Other difficulties include inadequate teacher training, inequity of access for disadvantaged students, lack of research and development on how to integrate computers into existing curricula or how to adapt curricula to incorporate this technology; and charges that they have been oversold. Since some experts are beginning to question the value of the current uses of computers in schools, the need for R&D on the full potential of this technology is particularly important. Congress may want to continue monitoring the use of computers in schools with respect to appropriate use and equitable benefits to students.

10. INTERNATIONAL SCIENCE AND TECHNOLOGY

See also items:

1.10 THE FUTURE OF U.S. SCIENCE

5.3 OVERSIGHT AND FUNDING OF MAGNETIC FUSION R&D

5.5 PROSPECTS FOR U.S. ASSISTANCE TO CHINESE R&D FOR NUCLEAR POWER

15.10 INTERNATIONAL SPACE ACTIVITIES

18.6 THE INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAM

SCIENCE, TECHNOLOGY, AND AMERICAN DIPLOMACY

Issue

During 1984 both the State Department and the National Science Board initiated actions to improve the formulation and administration of policies at the interface of science, technology, and diplomacy. Congressional oversight of the progress made to implement the recommended reforms and to design other needed actions may be appropriate.

Background

Science and technology generally have not been accorded the same level of attention as economic and political affairs by the State Department. Several efforts have been made during the last 25 years to rectify this situation. During 1984, the Department of State released an "action plan", entitled "Recommended Actions to Improve the Integration of Science and Technology in the Department of State." It focused specifically on strengthening personnel recruitment, training, and development, as well as reporting and management activities at the nexus of science, technology, and foreign policy. The recommendation also dealt with developing better relationships with technical agencies. The plan did not address all or, according to some critics, even the fundamental obstacles to elevating the stature of science and technology in the State Department. However, it has been widely perceived as a "working document", which would set in motion incremental personnel and management changes. The Secretary of State sent two cables to chiefs of mission to stress the importance of international science and technology, and the State Department held a conference in Vienna with science attaches in August 1984 to activate programmatic changes.

Additionally, in May 1984 the National Science Board, governing body of the National Science Foundation (NSF), citing inadequacies in the way NSF (1) determines priorities for international science and (2) manages programs and policies, endorsed a report, entitled Roles and Responsibilities of the National Science Foundation for Aspects of International Cooperation Related to the Health of American Science, and requested that the NSF Director use high-level nongovernmental personnel in international scientific meetings and in related negotiations; appoint a Special Assistant for International Affairs to improve coordination with other agencies; develop a broader information base to manage international science; and explore taking on a "leadership" role with respect to international science activities.

Analysis

The need to improve the formulation and administration of U.S. policies for foreign and international science and technology seems pervasive to critics, less so to the State Department. The Committee may want to oversee implementation of the recommendations, to determine if desired impacts are being achieved and whether such additional changes are warranted, such as providing a science "cone" and better career growth opportunities for "science officers", creating a position of chief science advisor to the Secretary of State, and overseeing the foreign scientific activities of the "technical" departments. It may also want to adjudicate the potential overlap between the Board's recommendation for a leadership role for NSF and the role of the State Department.

INTERNATIONAL SCIENTIFIC AND TECHNOLOGICAL COOPERATION

Issue

What are U.S. priorities and programs to ensure technological superiority and also mutually useful research with the Nation's allies in light of increasingly costly research and increasingly competitive foreign research capabilities?

Background

The criteria for determining U.S. priorities for international science and technology collaboration are unclear and it seem inevitable that Soviet, Japanese, and European science and technology will become increasingly competitive and outstrip U.S. achievements in some areas. Early in the Reagan Administration, Dr. George A. Keyworth, the President's science advisor, noted that the United States could no longer afford to be preeminent in all fields of science. As a result, perhaps, the United States withdrew funding from some large-scale cooperative projects with other nations, including Japan, some European countries, and the Soviet Union. Now, many nations charge that the United States is an unreliable partner in international science and technology, after decades of leadership in this area.

Nationalism, national security, and economic competition are potent obstacles to cooperation. These are reflected, for instance, in U.S.-European competition in high energy physics, manifested by the envy of some U.S. scientists about the discovery of the W particle at CERN, the European Center for Nuclear Research, and by the competitive atmosphere surrounding U.S. and European decisions to build separate, increasingly larger, and more costly superconducting supercollidors. The United States seeks international financial cooperation on some U.S. projects, such as the space station, and has agreed to cooperate in other kinds of research projects sanctioned during the Versailles summit meeting. Scientists have recommended funding, as yet uncommitted, for international cooperation in such other globally important areas as fusion research, tropospheric chemistry, and international geosphere-biosphere interactions.

Analysis

What are the Administration's priorities and policies for international scientific and technological cooperation? A wider public discussion of criteria to support and share science and technology might allay some of the mistrust engendered by recent U.S. withdrawal of support from committed projects and help the Congress to identify which areas of international cooperation warrant more support. The Committee may want to examine the following issues: the conclusion made by Robert Rycroft, of The George Washington University, that the information collected about U.S. programs and policies for international scientific and technological collaboration is inadequate for policymaking; the conclusion of the National Science Board of the National Science Foundation that the agency should assume responsibilities for determining U.S. priorities and policy for major international cooperative science; Congressman Don Fuqua's recommendation to create an International Parliament for Scientific and Technological Cooperation, to help identify and finance costly projects of global import that require multilateral efforts; and the recommendation of Rustum Roy, of Pennsylvania State University, that, "In some fields a target could be set of conducting one-fourth of all projects jointly with scientists abroad by 1990. This could take the form of a temporary measure designed to overcome years of isolation. After being force-fed awhile, U.S. and foreign collaboration in science could flourish on its own."

COOPERATION IN LARGE-SCALE OR "MEGAPROJECTS"

Issue

What are the opportunities and difficulties for domestic and international cooperation in large-scale public and private R&D projects?

Background

Several areas of R&D are referred to as "big science" because they typically involve the mobilization of large amounts of money and/or manpower resources for the construction and operation of facilities and projects. These areas typically include high energy physics, space R&D, oceanography, and optical and radio astronomy, although other scientific and technological facilities and projects not falling within these fields also may be considered magaprojects in some cases.

Although many "big science" or scientific magaprojects are undertaken by one country alone, other , like the International Geophysical Year or the European Center for Nuclear Research (CERN), involve several nations, either because of the high costs involved (a principal consideration in the case of CERN) or because the project simply could not be handled adequately by one nation alone (as in the case of the International Geophysical Year).

Recently, and particularly during the Reagan Administration, the United States has moved toward applying the concepts or criteria of "pertinence and excellence" to federally-supported R&D. These criteria, particularly when applied to some large R&D projects, may suggest that the United States now cannot undertake, by itself, all those projects which, in the past, it might not have questioned undertaking alone. Thus, in the future, there may be more support or pressure for U.S. cooperation in scientific magaprojects than has been the case in the past, during which the United States sometimes has been accused of "flickleness" in its, on the whole, generous support of big science projects.

Analysis

A number of issues have been identified in recent reports which bear upon what opportunities and problems exist for cooperation, particularly international cooperation, in scientific magaprojects. A recent report done for the National Science Foundation on International Cooperation in Science: The U.S. Role in Magaprojects, for example, lists as opportunities and benefits--making greater resources available, in terms of information, knowledge, and know-how necessary for any scientific activity; making possible a wider range of topics and a broader range of approaches, reducing the financial burden on all participants; speeding up the entire innovation process, from basic research to application; reducing wasteful redundancy; and enhancing good will and communication among the participants--and as difficulties and costs--inherent difficulties in meshing disparate national bureaucracies; delays in reaching decisions among differing political and legal systems; complications of varying decision processes, priorities, and competencies; costs of international bureaucracy; the danger that political inertia, which makes projects hard to start, but even harder to stop, will dominate; the possibility of drains on national research budgets because of international commitments; the tendency to undertake, internationally, only low-priority projects; and the apparent conflict between cooperation and improving a nation's competitive position.

The Congress may wish to address the risks of, and impediments to, cooperation in scientific megaprojects as well as the potential benefits in the interest of better evaluating future Federal scientific programs and projects which may be candidates for "big science" cooperation.

THE ROLE OF SCIENTISTS AND TECHNICAL EXPERTS IN THE MULTILATERAL BANKS

Issue

Examination of the role and status of technical experts, including experts in the design and implementation of national scientific and technological infrastructural institutions, in the World Bank and in the other multilateral assistance organizations.

Background

The multilateral assistance organizations of the United States complex, including the World Bank (International Bank for Reconstruction and Development), have focused their energies largely on the economic and financial aspects of development assistance to emerging nations, and on the macroeconomic management policies of those countries.

In addition, these organizations, and especially the World Bank, make extensive use of scientific, engineering, and technological expertise in the design and evaluation of project assistance proposals in such areas as infrastructure (such as ports, highways, communications, and electric power), industrial development (such as construction methods, manufacturing, and process control), and large-scale international cooperative R&D programs in such areas as agriculture and health. In addition to project-level expertise, technical experts provide advice on a strategic level, for example, in advising whether countries should pursue development strategies based on agricultural self-sufficiency, small-scale and village industrial development, or large-scale export-led heavy industrial production. Also, science and technology experts advise on the design of national systems for research, technical assistance, technology transfer, and scientific and technical education.

Recently, the international organizations have come under increasing pressure, especially from the United States representatives, to tie development assistance to structural adjustment policies and to deemphasize assistance for industrial development. In addition, the world economic situation of high interest rates and high third-world debt have reduced the capabilities of many nations to make use of the Bank's assistance. Also, the Reagan Administration has expressed its strong preference for market relationships as the arbiter of investment decisions, and there has been pressure from some U.S. industries to reduce assistance to potential competitors. Finally, some of the traditional debtor nations have substantially strengthened their own scientific and technical capabilities. As a result of these influences, the status in the World Bank of its scientific, engineering, and industrial experts has been reduced and the Bank has come to depend more on external technical expertise and on its internal economic staff.

Analysis

History shows that science and technology, and especially the development of indigenous capacity to develop, manage, and adapt technology, have been extremely important to sustained economic development. The Committee may wish to examine the role that technical experts are now playing in the multilateral development assistance organizations to determine whether the United States should consider steps to strengthen or modify the technical capabilities of the Bank's staff.

THE INTERNATIONAL AGRICULTURAL RESEARCH SYSTEM

Issue

In spite of the green revolution of the 1970s, massive numbers of the world's population continue to suffer from malnutrition and thousands die of starvation each year. Even with current technology and resources, global hunger and the lack of agricultural development remain priority concerns. Despite some notable successes, leaders have noted problems in developing cost-effective and program-efficient models for the delivery of new scientific and technical knowledge to Third World farmers.

Background

The United States has a long and enviable record of sharing knowledge and technology with other countries. However, drought, crop failures, and famine in several areas of the world have dramatically demonstrated that food supplies are not unlimited and that the United States alone cannot be the bread basket for a hungary world. Many countries of the world are calorie or protein deficient.

The strength of the world food and agricultural science and education system depends on an ample supply of high quality people in scientific and technical positions. The Joint Council of Food and Agricultural Science has reported that the number of highly capable students entering advanced degree programs in basic agricultural scientific disciplines is not sufficient to meet the world's needs in the decades ahead.

Analysis

The Committee may wish to focus on ways to improve the effectiveness and efficiency of the international agricultural research system by investigating the following questions: Should changes in the higher education system be considered to assure development of scientific and professional expertise in sufficient numbers to meet world needs? How might additional organizational linkages be created to improve the information flow, communication, and coordination among the many organizations engaged in international science and education? What steps can be taken to promote scientific cooperation among the developed countries, several of which are ahead of the United States in selected technologies relevant to agriculture?

ENVIRONMENTAL EFFECTS OF INTERNATIONAL AGRICULTURAL DEVELOPMENT PROJECTS

Issue

In many areas of the world where food availability is a severe problem, agricultural development assistance has been made available on a large scale. Yet failure to take into account natural conditions and constraints in planning development projects has often led to environmental damage that undermines the success of such projects and makes them unsustainable. How can the United States mobilize the research capabilities in the United States to identify and develop effective, appropriate agricultural techniques for use in developing countries, incorporating natural resource and environmental factors so that the result is sustainable?

Background

Neglect of environmental considerations has led to failure to achieve sustainable development goals in many types of projects in countries around the world. The result is large-scale global resource and land degradation, and substantial loss of productive capacity. Among the types of problems that affect large-scale development projects--bringing about the need for expensive corrective measures, or abandonment of the project altogether--are the following: tropical forest clearing projects for agriculture that neglect the extremely poor quality of lateritic solids, resulting in severe fall-off in productivity after two or three growing seasons; large dams with adjacent agricultural developments that fail to provide watershed protection, resulting in large-scale siltation of the reservoir; irrigation projects that are poorly designed and result in specialization of soils, with resultant sterility and total loss of productive capacity (it is estimated that irrigation-caused soil degradation results in as much productive loss each year as is gained through new irrigation projects); and uncontrolled pesticide use, which may result in development of immunity by the pests, hugh further increases in pesticide use, and attendant environmental damage. Major increases in world-wide desertification, deforestation, and soil erosion are among the effects of inappropriate agricultural development.

Analysis

In a large number of cases, the reason for failures of agricultural development has been the transfer of technology that may be appropriate in some types of areas, but highly inappropriate in others. Research on what is appropriate in areas with various conditions and development of appropriate and innovative agricultural techniques are essential elements in efforts to assist developing countries. Recognition of the environmental and resource factors that are unique to specific areas and cultures are essential in such research and development. The guidelines used by most development assistance agencies, including the U.S. Agency for International Development (AID), the World Bank, and others, include mandates to consider environmental and resource factors. However, there is a reported lack of expertise on these matters at the project-planning level, and therefore little implementation of these guidelines during the planning stages. What is much needed in many cases is the application of the best possible research on appropriate techniques, making more likely the integration of the results into the planning processes for agricultural development.

GLOBAL ENVIRONMENTAL AND NATURAL RESOURCES MONITORING

Issue

Profound and far-reaching changes in global environmental conditions, some due largely to human activities, may threaten productivity and human health and welfare over the long-term. Many of these changes gradually occur over many years or decades, and can only be detected by monitoring over extended periods of time. How effective is the global monitoring system? What is the United States contributing and how is it benefitting? Are cutbacks in domestic programs, which support international monitoring programs, threatening the ability of the United States and the international community to detect and measure crucial changes in the global environment or resource base?

Background

Changes in the ozone layer, which threatens major human health effects, and changes in the world climate due to carbon dioxide buildup, are among the global changes that have been identified and measured by international monitoring. Some international monitoring efforts date back several decades and some are relatively new. In the 1970s, the United Nations Environment Programme (UNEP) initiated the Global Environmental Monitoring System (GEMS). The program is coordinative and catalytic; it does not operate actual monitoring systems. It is the only global, comprehensive system which attempts to tie together monitoring efforts on the range of environmental conditions--deforestation, desertification, climate change, ocean pollution, water quality, and air quality. GEMS has an ambitious mission, but operates on a budget of some $2 million per year. Given its low level of funding, it is widely agreed that GEMS is failing to meet the broader needs for global environmental monitoring.

In all monitoring programs, the actual collection of data is carried out almost entirely by individual nations as part of, or added onto, ongoing domestic monitoring programs. Therefore, cutbacks in domestic research or monitoring efforts in environmental areas may threaten the continuation of monitoring global trends in critical areas.

Major international organizations that conduct monitoring programs, using input from world-wide stations operated by individual nations, include the World Meteorological Organization (WMO), which monitors air quality, long-range transport of air pollutants (including acid rain), and climate change; the Food and Agricultural Organization (FAO), which monitors world forest cover, crop conditions, fisheries production, and drought conditions; the World Health Organization (WHO), which monitors health conditions and water quality; and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, which monitors oil pollution and marine environmental problems.

In most of these areas, the ability to monitor conditions on a world-wide basis has been revolutionized by the use of remote sensing, particularly satellite observations. The contribution of the Landsat satellites has been enormous, and the data from Landsat have been used most of the programs listed above. The continuation of a reliable series of data from Landsat or comparable satellites is critical to some of these data collection efforts, and so the future of the Landsat program and the availability of its data is an issue closely related to international monitoring efforts.

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Analysis

The United States has played a strong leadership role in the support of all the organizations that carry out international monitoring programs. In all programs, the data must be collected by individual nations, but the coordination and standardization which leads to meaningful detection and measurement of environmental trends must be done by an intergovernmental, international entity. Thus, both the domestic programs which collect the data, and the financial support for the international organization or entity which provides leadership and coordination, are critical elements in successful monitoring of global environmental and natural resource trends. In recent years, cutbacks in U.S. contributions to the UNEP program and many of the other agencies mentioned have been proposed or carried out. Domestic cutbacks in environmental and resource programs have reduced or terminated some monitoring programs.

Some investigation of impacts on global monitoring programs of such cutbacks, the current status of global environmental monitoring programs, and related issues would aid the Congress in identifying the appropriate level of U.S. support which would provide for the monitoring of global trends that are thought to be important.

11. LIFE SCIENCES AND BIOTECHNOLOGY

See also items:

3.3 EFFECTS OF NEW PLANT BIOTECHNOLOGIES ON AGRICULTURAL RESEARCH

3.6 IMPACT OF BIOTECHNOLOGY ON AGRICULTURAL PRICE SUPPORT PROGRAMS

8.3 REGULATION OF DIETARY CARCINOGENS

8.4 HEALTH RISKS OF ANTIBIOTIC AND ESTROGEN GROWTH PROMOTERS IN MEAT PRODUCTION

9.4 INFORMATION TECHNOLOGY IN HEALTH AND MEDICAL SCIENCES

See also section:

7. ENVIRONMENTAL HEALTH R&D

THE SOCIAL AND ETHICAL IMPLICATIONS OF HUMAN GENE THERAPY

Issue

Genetic diseases are perhaps the most widespread and burdensome of all human afflictions. Gene therapy offers the first possibility of a cure for certain types of genetic diseases by replacing a defective gene with its normal counterpart. Since the first attempt in humans could begin as early as the spring of 1985, society could be forced in the near future to determine the conditions under which gene therapy should be initiated.

Background

Genetic diseases are caused by defects in the hereditary material and, consequently, affected individuals can pass the disease on to their children. Every individual is believed to carry five to ten genes that could result in the birth of a baby with a serious hereditary disorder. Over 15 million people in the United States are affected by genetic disorders. Although palliative treatments have been developed for some genetic diseases, for most there is no available treatment.

All attempts at human therapy will require the prior approval of several separate review panels. A possible obstacle to gene therapy is the safecy of the technology, since it is unknown whether the introduction of a new gene could be detrimental. Although there have been several encouraging animal experiments using gene therapy, some individuals think that attempts in humans would be premature until further animal experiments have been completed. However, for most human genetic diseases, a corresponding animal disease has not been identified. Because of this and the severity of most genetic diseases, many think that human gene therapy experiments are warranted at the present time.

Analysis

An issue of considerable controversy associated with human gene therapy is the type of cell which is affected, either body or reproductive (egg and sperm) cells. Current proposals for gene therapy experiments would probably affect only body cells. Gene therapy on embryos would also affect the reproductive cells and therefore future generations. Although gene therapy on embryos might well have a greater chance of success and wider applicability to many more genetic diseases, a number of scientists have expressed concern about the possibility of causing permanent genetic damage to future generations. In order to improve the feasibility of gene therapy on embryos, numerous experiments involving human DNA, embryos, and fetuses would be required. Many individuals would have major objections to these types of experiments.

If and when gene therapy becomes feasible, it will probably be very expensive, as are other newly developed high technology medical procedures. How would the costs and benefits of gene therapy be distributed equitably throughout society? Could research funds be distributed adequately so that gene therapy treatments would be developed for as many of the 3000 human genetic diseases as possible? Most genetic diseases are extremely rare and it may not be economically feasible for the private sector to develop treatments for many of these diseases. Because the burden of health care costs will be a continually expanding problem for the Federal Government, solutions to this problem may be necessary in order to allocate scarce economic resources. If it will eliminate future health care costs, gene therapy may be a cost-effective expense. A 1980 report estimated that $3 billion in direct costs and foregone earnings are lost annually because of genetic disorders.

FEDERAL REGULATION OF RECOMBINANT DNA PRODUCTS

Issue

A number of biotechnology companies have used recombinant DNA techniques to develop products which now require testing outside the confines of a laboratory or manufacturing facility. The potential environmental effects of such "deliberate release" tests have been the subject of considerable controversy and are central to a highly publicized lawsuit involving the National Institutes of Health (NIH) Recombinant DNA Advisory Committee (RAC). The White House Office of Science and Technology Policy (OSTP) has recently published an initial report which suggests a coordinating mechanism for the regulation of biotechnology, including deliberate release experiments.

Background

Most of the original controversy concerning the health and safety risks of recombinant DNA subsided following the implementation of the NIH document "Guidelines for Research Involving Recombinant DNA Molecules," in June 1976. Because the NIH guidelines are legally binding only on researchers whose institution receives NIH funds, compliance by other Federal agencies and private industry is strictly voluntary. This fact, in combination with concerns over the environmental effects of releasing genetically "novel" organisms, has fueled the present debate on the regulation of recombinant DNA products.

On December 31, 1984, OSTP published in the Federal Register an initial report of an interagency working group on biotechnology. The report describes the existing laws that may be applicable to biotechnology and contains policy statements by EPA, FDA, and USDA describing the proposed regulatory approaches each agency will take. FDA will continue to use its existing regulatory process for approving recombinant DNA products. EPA intends to use the Toxic Substances Control ACT (TSCA) and the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) as mechanisms to evaluate potential hazards of biotechnology products. USDA plans to use its existing regulatory framework in combination with the NIH guidelines. All three agencies will conduct their product assessments on a case-by-case basis, employing internal staff, consultants, and expert advisory committees modeled after RAC. In addition, an interagency committee will serve to coordinate regulatory activities and a biotechnology science board will provide a coordinating forum for scientific review procedures.

Analysis

Problems have been cited in attempting to use existing statutes to regulate recombinant DNA products, particularly with regard to EPA. TSCA grants EPA authority to regulate chemical substances. However, the statute may not be broad enough in scope to apply to living organisms. There is no indication in either the statute or the legislative history that Congress intended TSCA to regulate life forms. Section five of TSCA allows EPA to regulate chemicals before they are synthesized for commercial purposes. However, research and development is normally exempt from section five, and therefore a "deliberate release" could occur without EPA review. The agency is considering an amendment to eliminate the R&D exemption for new field-tested microorganisms. R&D is not excluded under other sections of TSCA, but in all cases the burden is on EPA to demonstrate that the new product poses an unreasonable risk. At the present time, the absence of generally accepted principles of risk assessment for genetically engineered microorganisms does not allow EPA to develop specific guidelines on the level of test data and other information to be submitted for agency evaluation of these new products.

FIFRA allows EPA to regulate pesticide use. While the FIFRA review process is stronger than TSCA, the safety data required by EPA are primarily direct toxicity effects. Critics are concerned that genetically engineered microorganisms may cause harm through a variety of indirect effects and, therefore, may escape detection under FIFRA's current testing regulations. If necessary, some of these regulatory issues may be addressed during the reauthorization of TSCA and FIFRA in the 99th Congress.

INTERAGENCY COORDINATION OF BIOTECHNOLOGY RESEARCH

Issue

Several Federal agencies fund research on biotechnology, including the National Institutes of Health (NIH), the National Science Foundation (NSF), the United States Department of Agriculture (USDA), the Department of Defense (DOD), and the Department of Energy (DOE). To what extent is federally-funded research on biotechnology coordinated to avoid unnecessary overlaps and to target areas of national importance?

Background

There are several existing mechanisms that have been established to share information, set policy, and coordinate Federal activities in biotechnology, but not to coordinate research per se. All of these groups have multiple agency memberships. The Recombinant DNA Advisory Committee (RAC) advises the director of NIH on technical matters related to the Recombinant DNA Guidelines. The Agriculture Recombinant DNA Advisory Committee (ARAC) is similar in its function to RAC. The Cabinet Council Working Group on Biotechnology was formed to conduct a review of executive branch activities in biotechnology. An Interagency Working Group on Competitive and Transfer Aspects of Biotechnology was convened to focus on activities of executive branch agencies that affect the transfer of biotechnology abroad. Other such groups are the Interagency Risk Management Council, the NSF Interagency Committee on Plant Biology, and the Office of Naval Research Biotechnology Working Group.

Analysis

A July 1984 report prepared for NSF, entitled Study of Federal Biotechnology Policy Issues, identifies Federal interagency coordination as an issue of only medium priority. Several other issues were rated as being of much higher importance, only a few were rated less important. The report did, however, offer six suggestions for improving biotechnology information exchange and coordination among Federal agencies: expand the role and function of the NIH Office of Recombinant DNA Activities; establish a Federal interagency biotechnology coordinating group; adapt existing databases to include information on biotechnology-related activities; schedule special workshops on biotechnology; encourage informal ad hoc working groups; and encourage interagency exchange of technical personnel.

One possible mechanism for establishing interagency coordination of biotechnology research is the Federal Coordinating Council for Science, Engineering and Technology, or FCCSET, which was established in 1976 by P.L. 94-282. FCCSET recommends policies and other measures designed to provide more effective planning and administration of Federal scientific, engineering, and technological programs. FCCSET currently has ten committees on such topics as human subject research, super computers, ocean policy, and intellectual property law.

BIOTECHNOLOGY AND INTELLECTUAL PROPERTY LAW

Issue

Advances in biotechnology have created many public policy and legal issues, an example of which is the treatment of genetically engineered products under the patent system.

Background

Intellectual property is intangible and is protected by patents, trademarks, and copyrights, which are mandated by Federal statutory law, and by maintaining the subject matter as trade secrets. Trade secret rights arise primarily from State court decisions or laws.

A great deal of controversy arose recently when an attempt was made to patent a living organism. In Chakrabarty v. Diamond, Commissioner of Patents and Trademarks, the U.S. Supreme Court held that the fact that an invention consisted of living organisms did not preclude patent protection. In the Court's opinion, the important fact in determining whether the subject matter is patentable is if there has been human intervention. This particular case involved claims regarding laboratory-modified microorganisms that were capable of digesting oil.

Analysis

Many of the current issues involving biotechnology and intellectual property law are more appropriate for resolution by the courts than by Congress. However, there are a few points which might possibly profit from congressional attention. One such problem concerns deposit requirements for living organisms. Since it is impossible to describe living organisms adequately using figures and text, as is done with a machine or chemical composition, patented microorganisms are made available to the public through independent depositories, such as the American Type Culture Collection. No such arrangement exists, however, for multicellular organisms, and the logistics, maintenance, and distribution costs involved in such a facility would probably be prohibitive. Unless an invention is able to be described in words alone, some form of deposit will be required. It may, in the future, become necessary for Congress to modify the disclosure requirements of 35 U.S. Code, section 112 to ease the deposit requirement as was done with the Plant Patent Act which requires disclosure to be only "as complete as is reasonably possible."

Another potential series of problems involves the differences between U.S. patent laws and those of other countries. Many of these problems require negotiations between the respective countries. One such problem which has been addressed by Congress is the infringement of process patents by production in a foreign country. A process patent is a patent on the method or technology of making a product. Under current U.S. law, a U.S. process patent is not violated if a product is manufactured outside the United States using that patented process and then imported for sale in this country. All other major manufacturing countries have laws against process patent infringement by foreign production. This problem is particularly apparent for the biotechnology industry since shipping costs are trivial for many of this new industry's high cost/low weight products, such as interferon. A number of bills were introduced in the 98th Congress which attempted to address this problem, but none of the measures contained in these bills was passed.

MEDICAL TECHNOLOGY

Issue

What should be the Federal Government's role in supporting research on medical technologies? How should new medical technologies be disseminated? What should be the Government's role in evaluating and regulating their use, availability, and performance?

Background

The Office of Technology Assessment has defined medical technology to include drugs, devices, medical and surgical procedures, and the organizational and supportive systems within which medical care is provided. The Federal Government has traditionally played a substantial role in the basic research that underlies the development of many medical technologies. This type of research activity can frequently stimulate useful innovations in fields where there is not sufficient prospect of rapid profitability to attract private developers. Federal agencies, particularly the National Institutes of Health, have also been active in encouraging the transfer of technologies to the health care system. The Federal role has primarily involved providing information about technologies and supporting demonstrations of potential uses of new technologies.

In the evaluation of technologies, the Government has specific responsibilities for assuring the safety and efficacy of products such as drugs and medical devices. While no similar mandate exists for the assessment of medical and surgical procedures, the Public Health Service has been involved in evaluating a variety of technologies in order to make recommendations to the Health Care Financing Administration about Medicare coverage of the technologies. Responsibility for this function has passed successively from the former National Center for Health Care Technology to the Office of Health Technology Assessment and now to the newly expanded National Center for Health Services Research and Health Care Technology Assessment (P.L. 98-551). The new law also established a National Advisory Council on Health Care Technology Assessment to advise the Center, and provided for grants to establish a private sector Council on Health Care Technology.

Analysis

Pressures from rising health care costs will continue to increase in the coming years. The capability to evaluate medical technologies will assume even more importance as budgetary constraints force difficult choices about who should receive a particular technology, or who should provide it, or where it should be provided. Roles that can be fulfilled by the new public and private-sector bodies established in P.L. 98-551 include being a clearinghouse for assessment information, developing criteria and methodology on how to conduct assessments, and identifying needs. The health care community will be watching the new entities carefully for their contributions to current assessment activities.

CONTRACEPTIVE TECHNOLOGIES

Issue

The perfect contraceptive--one that is 100 percent effective, 100 percent safe, and would have no side effects, does not exist. However, the use of a number of contraceptives has been approved by the Federal Government. Each contraceptive has its own advantages and disadvantages. What responsibility does the Federal Government have to conduct or support research on new contraceptive technologies, then transmit information about these technologies to the public?

Background

More than 70 percent of the women attending family planning clinics during the 1960s and 1970s used oral contraceptives ("the pill") or interuterine contraceptive devices (IUD). Oral contraceptives are made up of chemicals that work by changing the level of hormones necessary for reproduction, and preventing conception from occurring. The IUD is a small device that is placed in a woman's uterus which prevents a fertilized egg from implanting (implantation is necessary in order for pregnancy to occur). Prior to the popularity of oral contraceptives and the IUD, a number of barrier methods--the condom, cap, and diaphram--and spermicides were the contraceptives of choice in the United States as in most of Western Europe. One disadvantage of these latter methods is that the failure rate is much higher than with the pill or IUD, 9.6 to 18.6 percent compared to 2.4 percent and 5 percent for the pill and IUD, respectively.

Reports of a number of adverse effects associated with use of the pill and the IUD between 1977 and 1983 contributed to a dramatic decline in the use of these two methods. These effects include cardiovascular disease, increased risk of certain types of cancer, and pelvic inflammatory disease.

Although researchers are looking for a contraceptive that is as effective as the pill but has no side effects, it has not been found. Currently an estimated one out of five married couples in the United States are turning to sterilization as a contraceptive means.

Analysis

Researchers and policymakers may wish to explore the state-of-the-art of existing technologies as well as available methods of transmitting information about the technologies to the public. Because of social and cultural factors in the United States and abroad, new advances in family planning methods may have global impacts on existing and future societies.

THE ROLE OF ETHICS IN MEDICINE

Issue

Medical technology advances have significantly improved prognoses for patients afflicted with a wide range of ailments, including heart disease, undeveloped lungs, and infertility. Some treatments that have been used to treat these disorders are the transplantation of mechanical, human, and animal hearts into patients with heart disease; use of respirators to aid premature infants in breathing; and application of a number of in vitro fertilization techniques to successfully treat infertility. The introduction of these medical developments to the health care system has been accompanied by a number of ethical dilemmas. What responsibility does the Federal Government have to address these ethical issues?

Background

In 1978, Congress passed a law (P.L. 95-622) which created the President's Commission for the Study of Ethical Problems in Medicine and Behavioral Research. This Commission consisted of 11 members, appointed by the President, from various fields, including biomedical research, medical practitioners, the humanities, theology, and law. (Membership terms were staggered. President Carter appointed the 11 initial Commission members, and 8 of the 11 commissioners at the end of the Commission's tenure were President Reagan's appointees.) During the Commission's tenure, which expired on March 31, 1983, it published nine reports addressing ethical issues related to topics such as foregoing life-sustaining treatments, defining death, genetic screening and counseling, and genetic engineering in human subjects.

Since the Commission's term ended in 1983, at least one attempt has been made, by Congress, to create a Biomedical Ethics Board in the legislative branch of the Federal Government (S. 540 of the 98th Congress). This board would have been charged with appointing a 12-member biomedical ethics advisory committee to address ethical issues associated with delivering health care and biomedical and behavioral research. However, the bill which would have established this body was pocket-vetoed in October 1984.

Analysis

As medical advances continue to occur, some believe that ethical dilemmas in medicine may be among the most urgent issues facing this country. Congress may wish to assess these issues and decide what role, if any, the Federal Government should have in addressing them.

12. MATERIALS R&D AND RELATED POLICY

AVAILABILITY OF STRATEGIC AND CRITICAL MATERIALS

Issue

The most secure source of materials is domestic production. However, maintaining security of minerals supply through domestic production is a complex issue related not only to geology, but, in part, to the economics of international trade, foreign minerals development, and domestic policy conflicts and institutional constraints. Options to assure an adequate and secure supply of strategic and critical materials vital to defense needs include developing materials substitutes, increased conservation and recycling, diversifying sources to safe neighboring countries, strengthening the National Defense Stockpile and/or enhancing private stockpiling, and evaluation of regulations and other measures which may have weakened the mining and minerals processing sectors without consideration of national security implications.

Background

Using more than four billion tons of new minerals each year, the United States is the world's largest consumer of raw materials. Imports provide about 40 percent of the Nation's petroleum requirements and U.S. industry is nearly 100 percent dependent on foreign sources for some of its most critical mineral needs. For example, as a percentage of total consumption in 1983, the United States relied on imports for 99 percent of its manganese, 96 percent of its cobalt, 77 percent of its chromium, and 84 percent of its platinum group metals. Of particular note is that the United States relies heavily on southern Africa--an area that continues to experience the pressures of political unrest and outside influences--for import of these metals. In peacetime, the choice to import is normally based on economic factors and does not equate to vulnerability. The stability of supply from the foreign sources and the availability of materials substitutes must also be considered.

Analysis

Increasing vulnerability to potential supply disruptions of strategic and critical materials could lead to economic impacts that may require severe adjustments for businesses whose supply chains are dependent on these materials. The situation warrants continued oversight and examination of questions such as: How can the domestic minerals producing industry be maintained and restored to a more healthy state while assuring adequate supplies of materials at prices established in competitive world markets? What is the advisability of attempting to increase self-sufficiency in basic raw materials and to what extent is this feasible? What is the appropriate role for the Federal Government to encourage domestic minerals production or the investment by domestic firms in foreign minerals development if such is desired? Congressional concern could also include review of the status of minerals exploration, materials research, and implementation of the National Critical Materials Act of 1984.

MARINE MINERALS RESEARCH AND DEVELOPMENT

Issue

At the forefront of marine research are recent and potential discoveries of mineral deposits within 200 miles of U.S. territory. These discoveries, of importance to the furtherance of scientific knowledge of ore formation and for potential minerals supply, have both stimulated and been fostered by recent advances in deep ocean research technology. Congressional concern could include review and determination of the appropriate Federal role in this research, including coordination of the efforts of NSF, USGS, and NOAA and use of the Navy's Deep Sea Research Vessel (DSRV) Alvin, and the recent declaration of a U.S. exclusive economic zone regarding the legal framework for any future mining activity.

Background

U.S. firms have played a leading role in developing the technological capability to recover and process manganese nodules from the deep ocean floor. While this technology has not been tested commercially, primarily as a result of uncertain economic conditions in metals markets, the potential for new sources of mineral supplies is vast. Most nodule deposits of economic interest have been found beyond 200 miles of U.S. territory. Now recent discoveries of cobalt crusts and polymetallic sulfide deposits, many within the newly established U.S. Exclusive Economic Zone (EEZ), are attracting interest. Mineral deposits within the EEZ avoid possible jurisdictional problems that may become associated with mineral resources found in areas beyond 200 miles from land which may become subject to a future regime to be established under the 1982 U.N. Law of the Sea Treaty. Although in agreement with many of the principles expressed in the new treaty, the United States has not signed it, primarily because of objections to provisions related to deep seabed mining. Meanwhile, on August 3, 1984, eight industrialized countries (Belgium, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Great Britain, and the United States) signed an agreement (Provisional Understanding Regarding Deep Seabed Matters) to avoid mine site conflicts in the issuance of national authorizations to explore and develop seabed areas beyond their national jurisdictions. These countries represent most of the major holders of the technical capability to recover nodules from the deep seabed. On August 29, 1984, the U.S. Government issued deep seabed mining exploration licenses to three of the four multinational consortia that had applied under the U.S. Deep Seabed Hard Mineral Resources Act.

Analysis

The U.S. decision not to sign the Law of the Sea Convention leaves domestic ocean mining interests with some measure of uncertainty regarding future access to potential mine sites and, in particular, uncertainty regarding resolution of possible overlapping claims with countries not party to the Provisional Understanding. The Committee may wish to examine the status of the domestic seabed mining industry with regard to its operation under the Deep Seabed Hard Mineral Resources Act versus possible future operation under the Law of the Sea Convention through consortia, members which are signatories to the Convention.

Discoveries of enriched polymetallic sulfide deposits within a 200-mile coastal zone of the United States helped provide the impetus to establish an exclusive economic zone for the United States similar to that defined in the Law of the Sea Convention. The Committee may wish to examine the extent to which these deposits may be economically viable and whether there may be need for legislation to facilitate and regulate their possible future recovery.

Research in ocean mineral formation and seafloor mapping is being conducted by several Federal agencies. Are these efforts adequately supported and is there sufficient cooperation and coordination to achieve maximum efficiency? To what extent are these newly found deposits contributing to increased understanding of ore genesis and how might this information be applied elsewhere?

HIGH TECHNOLOGY ADVANCED MATERIALS AND INTERNATIONAL COMPETITIVENESS

Issue

Advanced materials such as ceramics, composites, and advanced polymers are growing in prominence both here and abroad. Foreign research and development in advanced materials may be outstripping U.S. efforts. Is this, in fact, a cause for concern, and if so, how should the Federal Government respond?

Background

Fruitful research and development of advanced materials could be essential to ensure the competitiveness of high-technology and basic industries. For example, it has been estimated that an instant ceramic market of $5 billion will be available when advanced structural ceramics become sufficiently developed and that businesses worth $50 billion will become obsolete unless they adopt new ceramic technologies. A recent National Materials Advisory Board study concluded that Japan is significantly ahead of the United States in the development of these ceramic materials. Cooperative government-industry programs are believed to contribute to Japan's success; MITI has launched a "Next Generation Industry" program which sets technological objectives and research strategies for ceramics as well as other materials, such as electro-conductive polymers, crystalline polymers, and advanced composites.

Based on the perception that the United States, unlike other nations, has not implemented specific long-term research and technology programs to develop advanced materials, Congress passed the National Critical Materials Act of 1984 (P.L. 98-373). The Act requires the Administration to create a National Critical Materials Council whose responsibilities include "establishing a national Federal program for advanced materials research and technology".

Analysis

Congress may wish to identify which kind of long-term programs, policies, and strategies can enhance U.S. industrial competitiveness in advanced materials. Elements of such a national program could include the establishment of specific long-term R&D priorities; cost sharing and/or cooperative research programs between government, universities, and the private sector; ensuring adequate instrumentation and high-quality personnel needed to support the Nation's materials R&D infrastructure; developing mechanisms for gathering and disseminating information on foreign materials technology advances; and stimulating innovation and technology utilization in advanced materials industries.

LEAPFROG TECHNOLOGIES AND THE STEEL INDUSTRY: THE FEDERAL ROLE

Issue

Many observers believe that the U.S. steel industry must develop and adopt new technologies to survive in the world market. What role, if any, should the Federal Government play in stimulating the development of these new technologies?

Background

Before 1950, the American steel industry supplied over half of the world's raw steel. Today it accounts for only about 12 percent of world raw steel production, and the Nation imports nearly one-sixth of the steel it uses. Many believe that intensive efforts to identify, develop, and implement radical and innovative technologies are necessary to help restore the industry's competitiveness in the world market. Ideally, new technologies (such as rapid in-process analysis of molten steel, or direct casting of thin sheet) would "leapfrog" state-of-the-art technologies currently employed throughout the world and would lower steelmaking costs by consuming less energy, allowing the use of cheaper raw materials, requiring fewer personnel in operation and maintenance, and meeting more stringent product specifications.

The American Iron and Steel Institute has identified a host of high-risk, long-term technologies which could radically change and improve the steelmaking process. No single company has the resources to develop these technologies and advocates assert that the Federal Government must play a role in nurturing the research and development of these technologies.

Analysis

Congress may wish to consider several strategies for the development of leapfrog technologies by the steel industry. These would include government-sponsored pilot projects, the fostering of joint industry research efforts, and government-industry collaborative undertakings in which Federal facilities and personnel are used. Programs of this nature have been proposed and some are already underway.

Critics caution that improved technology alone will not save the steel industry and that more deep-seated economic problems, such as international trade practices, the strength of the dollar abroad, and high labor cost, also must be addressed. Some observers also warn that once a new technology is developed, it will eventually spread to steelmakers throughout the world, thus eliminating any long-term competitive advantage the domestic steel industry may hope to gain.

13. SCIENTIFIC AND ENGINEERING EDUCATION AND MANPOWER

See also item:

9.6 COMPUTERS IN EDUCATION

SCIENCE AND ENGINEERING EDUCATION

Issue

The purpose of the Education for Economic Security Act (P.L. 98-377) is to improve the quality of mathematics, science, and engineering instruction throughout the Nation. The 99th Congress may wish to consider how the provisions of this law will be implemented by the National Science Foundation and Department of Education, as well as the probable need to reauthorize the stipulated programs for funding beyond FY85.

Background

On August 11, 1984, the President signed H.R. 1310, the Education for Economic Security Act (P.L. 98-377). The bill authorizes, for the improvement of science, mathematics, and engineering education, a total of $569 million for FY84--of which $75 million are to go to the National Science Foundation (NSF) and $350 million to the Departmen to Education--and $685 million for FY85--of which $139 million are allotted to NSF and $582 million to the Department of Education. The remaining funds are authorized for the Environmental Protection Agency for a five-year asbestos abatement program. Also, the Act authorizes a "magnet schools" program to be administered by the Department of Education, in addition to a provision for equal access to student groups wishing to use school facilities after school hours for religious and other kinds of activities.

According to an article in the September 28, 1984 issue of Science magazine, "NSF has been moving slowly on spending funds it already has for science and math education and is still grappling with some basic policy questions in respect to its education program." Also, the article continues, "the new law gives the foundation some procedural directions that appear to go against the grain of standard NSF practice." Some critics believe that the law outlines funding procedures more suitable to the Department of Education, which distributes funds through block grants to the States on a formula basis, than to NSF. These critics believe that the law may cause administrative problems for the Foundation which usually awards small grants on a competitive basis.

By October 1984, no funds had been appropriated for the enactment of NSF programs under P.L. 98-377 and the funding outlook appears uncertain. The FY85 NSF appropriations (P.L. 98-371), however, included $82 million for science and engineering education programs which may include funding for some programs that were authorized in P.L. 98-377. In October 1984, Congress passed a continuing resolution for funding government programs, of which $100 million was appropriated to the Department of Education for programs authorized by P.L. 98-377. Since funding was not appropriated for FY84 and FY85 for P.L. 98-377 programs, as the law authorized, action may be considered by the 99th Congress to authorize monies for FY85 and FY86.

Analysis

When the President signed H.R. 1310 into law, he issued a statement that indicated his reservations regarding provisions for science and mathematics education programs. He stated that he was pleased with the emphasis placed on teacher training in improving the quality of science and mathematics education through programs authorized for the Department of Education and the on-going NSF science, mathematics, and engineering programs. Also, he was pleased with the equal access provisions of the

bill. "H.R. 1310", however, "is far from perfect", he stated, and has a number of "serious weaknesses". He stated that the bill was "too expensive"; had "too many complex and administratively burdensome programs; duplicates some existing activities; it authorizes unnecessary or inappropriate programs that are unrelated to improving science and mathematics instruction . . .; and it denies State and local governments the broad flexibility and decisionmaking authority they need to address local educational needs in the most effective manner." The President's approval of H.R. 1310 did not, he explained, endorse the "objectionable provisions of the bill."

In view of these facts, the 99th Congress may deal with appropriating or reappropriating funds for programs enacted by P.L. 98-377, many of which are objectionable to the Administration. What bearing, if any, will the attitude of the Administration have on congressional actions taken and oversight in regard to the law?

EFFECTS OF PERSONNEL POLICIES ON FEDERALLY-PERFORMED RESEARCH AND DEVELOPMENT

Issue

What is the effect of Federal personnel policies, including ceilings on grade-level distributions and on salaries, on the hiring and retention of first-quality scientists and engineers in the Federal laboratories, and on the quality of the scientific and technical work performed in them?

Background

The performance of any research institution depends critically on the quality of its personnel and on the methods and structures used to support and manage their efforts. Personnel quality depends, in turn, on a number of factors -- tangible ones such as salary and benefits, and intangible ones such as recognition and the opportunity for service -- that influence researchers to join and remain in an organization. There is evidence that Federal personnel policies are making it increasingly difficult to maintain staff quality. In its report of May 1983, the White House Science Council's Federal Laboratory Review Panel (the "Packard Report") noted that:

> . . . almost all of the Federal laboratories, both government-operated and contractor-operated, suffer serious disadvantages in their inabilities to attract, retain, and motivate scientific and technical personnel required to fulfill their missions. The principal disadvantage is the inability . . . to provide . . . competitive compensation at entry and top senior levels.

Recent and proposed reductions of Federal workers' benefits have further weakened the attractiveness of Federal employment. Combating "grade creep" by imposing agency-wide limitations on the proportion of employees that can hold higher grade positions blocks promotions and exacerbates the salary problem. Unlike many Federal employees, who perform specialized functions that are not in demand in the private sector, Government scientists and engineers usually have many opportunities outside Federal service. In addition, technical employees may have stronger loyalties to their work and their profession than to their employer, which may make them more receptive to alternative opportunities than some other types of employees.

Analysis

As part of its oversight responsibility for Federal R&D and the effective conduct of national science and technology policy, the Committee may wish to investigate whether Federal personnel policies and practices affect Federal scientific and technical performance. A review of the implementation of the recommendations of the Packard Report might provide a constructive point of entry. In addition, a review might be made of the personnel practices of several major agencies and departments that employ engineers and scientists, such as the Departments of Energy, Commerce, and Health and Human Services, as well as NASA, EPA and NSF. The arguments supporting special personnel policies for certain professions, such as medicine, psychology, and the foreign service, might be examined to determine whether they should be extended to research engineers, scientists, and technicians.

14. SOCIAL SCIENCES RESEARCH

THE USE OF THE SOCIAL SCIENCES

Issue

The use of social science knowledge in social policymaking and institution building is affected by problems in the conduct of research and by funding patterns, which are influenced by public perceptions of the utility of social science research. Funding decisions should consider social utility and also the need to invest in social science as a science, although it might generate knowledge of little immediate utility. The current policy debate about retrenchment in funding deals, in part, with these complex issues and may profit from legislative consideration.

Background

A considerable body of literature, especially in the field of social program evaluation, identifies factors in the research production cycle which affect the use of social science knowledge. These include the need for clear communication and involvement of decisionmakers, the timeliness of report writing, and building social data retrieval systems into program management. Researchers need to be aware of user involvement and the Congress needs continual assurance that federally-funded social research projects accommodate these factors.

However, other, less controllable, factors also affect use. The research agenda of the social sciences, the ultimate denominator of use, especially of policy-oriented social science research projects, is often determined by political and economic issues. Similarly, the use and effectiveness of social science knowledge is affected not only by the technical caliber or "correctness" of the knowledge, but also by social, political, and personal interpretations. Some social science knowledge is rejected because it is perceived as a commonsense explanation of human behavior; some is rejected because it is counterintuitive or, as Kenneth Prewitt, the President of the Social Science Research Council writes, "subversive of existing social, economic and cultural arrangements; and for that reason it will be opposed even as effectiveness is displayed."

The natural propensity to judge funding for social science research on the bases of social utility and personal interpretation is not raised as often in regard to other sciences, leading the National Academy of Sciences to comment that ". . . [T]here are dangers in singling out the behavioral and social sciences for measurement against a standard of social utility. Efforts to extend the frontiers of knowledge are fully justifiable in their own terms dependent only on their progress in altering the scientific understandings that were their original points of departure." Federal funding for social science research decreased ten percent from fiscal year 1980 to 1985, while funding for all other sciences increased 41 percent. How have questions of ideology and utility affected these funding patterns?

Analysis

The Committee may want to examine the need to strike a balance in Federal support between policy-relevant social research that may not necessarily conform to the rigorous requirements of science and scholarly research and which might challenge current assumptions of social good, but which might constitute knowledge essential for the long-term development of the disciplines and the well-being of the Nation.

FEDERAL SUPPORT FOR SOCIAL SCIENCE RESEARCH

Issue

The Reagan Administration made discernible realignments and major budget cuts for some kinds of psychological and social science research during the period 1980 to 1985. Psychology research support increased, but support for non-defense-related psychology decreased from 68 to 60 percent of the psychology research budget. The Federal research budget increased about 41 percent since 1980, but support for non-defense social science research decreased ten percent and support for military social research increased 35 percent during this period. The Committee may wish to examine the implications of these funding patterns on the knowledge base and personnel supply of these disciplines, and future capacities to respond to public and private knowledge requirements.

Background

The Reagan Administration has clear-cut funding priorities for psychological and social science research. In 1980 Federal support for social science research stood at $523,811,000; two years later support had been reduced by 26 percent. A gradual increase began the next fiscal year, and estimated funding for social science research is $473,946,000 for FY85, a reduction of ten percent since 1980. Support for social science research constituted 4.5 percent of the Federal research budget in 1980 and three percent in 1985. During this period, DOD social research funding increased by 35 percent. Support for psychological sciences manifests a different trend--an increase of almost 50 percent since fiscal year 1980. Federal support for psychology has been realigned since the biggest increase for any agency, at 80 percent, was for DOD research in psychology, which now constitutes about 40 percent of the Federal psychology budget, up from 32 percent in 1980. In constrast the HHS budget for psychology increased only 40 percent, and the NSF budget for such research went up only 15 percent.

OMB documents justified funding reductions on the basis that social science research programs were lower priority than other sciences and would contribute less to economic recovery. Some critics charged that the cuts are ideologically motivated, that is, that the Administration seeks to withhold support especially for scientists who would, presumably, advocate "liberal reforms" and governmental intervention for social change. For instance, biological, rather than behavioral or social factors, are being stressed in the Alcohol, Drug, and Mental Health Administration, and the agency rejects some social problem research as unacceptable for support. Generally, social sciences, despite their contributions to understanding of the economy, electoral behavior, or family structure, have begun to be regarded with considerable criticism. The objectivity and integrity of the social sciences are being questioned by some "hard scientists" and the lay public. As a result, the manpower supply and knowledge base of the social sciences is seen by some as shrinking. Congressional action has mitigated some of the cuts, but generally has not altered the course of the Administration's funding policies.

Some observers say that funding cutbacks have prompted a healthy period of reassessment by social scientists. The National Academy of Sciences is preparing a report, due in 1986, that will identify a ten-year program of research opportunities and priorities for the behavioral and social sciences.

Analysis

The National Science Board and other scientific advisory groups have questioned the propriety of these trends. The Committee may want to assess the implications of funding changes, and their effects on the training of scientific personnel, the generation of knowledge necessary to sustain governmental and nongovernmental programs for mental and social health, the continuation of useful social survey databases, the maintenance of a balance between theoretical and applied work necessary to strengthen these sciences as national resources, and the pros and cons of nongovernmental patterns of funding.

THE IMPACT OF SOCIAL SCIENCE RESEARCH ON INDUSTRIAL PROCESSES

Issue

The current debate on the declining rate of productivity growth has largely ignored the contributions of social science research. Innovation and productivity issues are not only technical, but also organizational and social, with social science research operating as a factor in raising the efficiency and productivity of industry. Advocates argue that the United States has been slower than many other industrialized nations in recognizing the importance of this approach and putting it to productive use. The continued deemphasis of social science research may be detrimental to the Nation's efforts to achieve economic and technological revitalization.

Background

Social science research has the potential for examining the factors that both enhance and inhibit productivity and innovation. Some social science research concerned with the innovation process has focused on specific technologies that have implications for national productivity. Areas of technology which are derived from social science research are demographic analysis, projections, and economic forecasting models, based on econometrics; human factor engineering, based on information sciences and physiological psychology; market research, based on survey research and sampling theory; and management of foreign exchange risks, with bases in risk analysis and international economics.

The Reagan Administration's FY81 to FY85 budgets made major realignments in social science research programs. The Administration justified its early cuts in funding for some social and behavioral science research on the basis that these sciences were of lower priority and lesser importance to economic growth than the natural sciences. However, funding for social and behavioral science research increased in the Administration's FY86 budget request.

Some psychologists contend that a factor contributing to the past period of slowing U.S. productivity growth is the lack of effective coordination between human resource development and technological development. Erich Bloch, Director of the National Science Foundation, has stated that the social and behavioral sciences are necessary to better understand changes in world economic competition; in the increasing complexity of science, technology, and the research process; and in international competition in research. Bloch pointed out that the pursuit of technological innovation can only be accomplished by an examination of the social context in which it occurs.

Analysis

Some contend that social science methodologies have proven their ability to increase national innovation and productivity. Other countries have borrowed from U.S. social science research, mainly in regard to organizational structures and management styles, in order to gain economic advantages. Policymakers may be concerned with strengthening the organization of domestic resources and providing incentives to industry and State and local governments to develop, market, and disseminate different product-enhancing social and managerial technologies.

Another issue requiring additional public policy consideration is Federal support for the social sciences. In FY80, 4.5 percent of Federal obligations for total research went for the social sciences. The FY85 estmate is approximately three percent. The Committee may want to examine whether increased Federal support for research on the social dimensions of an increasingly technological society is critical.

The Economic Recovery Tax Act of 1981 provided tax credits to corporations for most kinds of new research. The intention of the Economic Recovery Tax Act was to increase technological innovation and productivity by stimulating private

sector research and development. However, this act explicitly excluded social science research from qualifying for such R&D tax credits. With the exclusion of the social sciences as "qualified research", the tax credit overlooks important areas of research that have the potential to revitalize the economy and promote technological growth. Congress may wish to consider amending the Economic Recovery Tax Act to include behavioral and social science research.

15. SPACE RESEARCH AND DEVELOPMENT

See also items:

5.4 NUCLEAR REACTORS FOR SPACE

10.7 GLOBAL ENVIRONMENTAL AND NATURAL RESOURCES MONITORING

18.5 OCEAN-SENSING SATELLITES

SPACE GOALS AND THE NATIONAL COMMISSION ON SPACE

Issue

With the space shuttle operational and the space station approved for development, attention is now focusing on what the Nation's long-term space goals should be, especially for NASA. A National Commission on Space was established in 1984, but by January 1985, the members had not been named, and there is a question as to how great a role the Commission will play in formulating long-term space goals.

Background

Following the Apollo lunar landing in 1969, a Space Task Group was established in the executive branch to look at goals for the "post-Apollo" U.S. space program. The Task Group's recommendations included a reusable manned spacecraft, a space station, bases on the Moon, and manned missions to Mars. Although the budget situation in the early 1970s did not permit initiation of all these programs, the United States now has the reusable manned spacecraft (the space shuttle), and development of a space station has been approved by the President and first year funding provided by Congress. Thus, attention has now turned to lunar bases and manned Mars exploration.

Congress has routinely looked at the future of the U.S. space program through the hearings process, but, in 1984, it was decided that a commission should be formed to look at space goals for the next 20 years. Language creating a National Commission on Space was included in the FY85 NASA Authorization bill (P.L. 98-361), and President Reagan signed an Executive Order on October 12, 1984 formally establishing the Commission. By January 1985, however, the members of the Commission had not been named by the White House. The Commission has only one year from the date of the Executive Order to report its findings, and the longer it takes for the members to be named, the less time will be available for deliberations. There is some speculation that the White House is deliberately taking a long time to name the members so that they will have little time to formulate recommendations, thus calling into question how much impact their findings will actually have on the space program.

Analysis

Issues that may be addressed by the 99th Congress include not only what the future goals should be for NASA, but the overall need for identifying long-term goals for an R&D agency. NASA is often criticized for always wanting more and more money for "pie in the sky" programs, but is simultaneously criticized for not looking far enough ahead. The political acceptability of goals such as lunar bases and manned missions to Mars is questionable in an era of large budget deficits, even though the programs might not be planned for 10 or 15 years.

Another issue may be oversight of the National Commission on Space, and whether or not Congress should extend the period of time it has to report its findings to Congress. In addition, the Executive Order establishing the Commission gave NASA somewhat more power in terms of staffing the Commission than may have been intended by Congress, and oversight of NASA's influence on the Commission's findings may also be an issue. Furthermore, the disposition of the Commission's recommendations (that is, whether the White House incorporates them in future planning for NASA or simply puts them on the shelf) may be of interest.

NASA'S SPACE SCIENCE PROGRAM

Issue

Space science advocates are concerned that their programs will suffer as a result of the decision to proceed with deployment of a permanently occupied space station, just as they allege that space science programs suffered because of the Apollo and space shuttle programs.

Background

The 1959 NASA organic act includes the objective of expanding human knowledge of phenomena in the atmosphere and space, and NASA has an active unmanned space science program, comprising a variety of programs for earth orbital, lunar, planetary, and interplanetary research, to meet that objective.

Since the early 1960s, there has been a debate over the need for manned spacecraft to pursue space science goals, for example, whether exploration of the Moon could have been accomplished more quickly and less expensively without the Apollo program. Space scientists often argue that the expensive manned programs have detracted from the pursuit of space science by taking away needed financial resources from unmanned programs, as well as from activities to analyze the data returned from them. In recent years, Congress has paid particular attention to the latter activities, adding money from planetary and physics and astronomy research and analysis. Concern over the health of the space science program arose again when the decision was made to pursue a manned space station as the next major NASA program because space scientists are concerned that their programs will have to pay the price.

Supporters of the manned programs argue that the space scientist's fears are without foundation, and that space science has received a relatively level percentage of the NASA budget throughout its history; the problem is simply that as the entire NASA budget has been reduced, so has the budget for space science. Also, they assert that without the publicly popular programs like the space station, NASA as an agency would not receive as much support as it does, and even less funding would therefore be available for space science (i.e., if manned programs were removed from the NASA budget, that does not necessarily mean that more funding would become available for space science--it might simply be eliminated from the budget entirely and NASA as an agency would suffer).

One avenue suggested by planetary scientists for enabling a logical approach to exploring the planets is to create a "planetary observer" line item in the NASA budget at a level amount each year (perhaps $300 million) with which they can plan what missions to fly in what order, rather than experiencing cyclical peaks and valleys of funding availability. Although the first "planetary observer" spacecraft has been approved, the annual line item approach has not.

Analysis

Issues surrounding the space science program include support for research and analysis activities associated with the planetary and the physics and astronomy programs; the health of the space science program in general and the potential impact of the NASA space station program on available funding for space science activities; the need for a "planetary observer" line item in the NASA budget to support planetary exploration; and continued oversight of the Space Telescope program.

SPACE SHUTTLE PRICING POLICY

Issue

The price which NASA charges users of the shuttle has been controversial for many years because of NASA's attempts to charge simultaneously a price which users can afford, maintain competitiveness with the European Ariane launch vehicle, and recover the costs of launching the shuttle. The issue has gained more prominence recently because of charges that NASA is unfairly subsidizing the shuttle, making it impossible for other U.S. launch vehicle companies to compete with it.

Background

When the space shuttle program was initiated in 1972, it was with the understanding that once the shuttle was operational, the older type of rocket, known as an expendable launch vehicle (ELV), would be phased out and the shuttle would be used for all U.S. launches. At that time, only the United States and Soviet Union were capable of launching relatively large satellites. NASA was projecting 572 shuttle launches over a 12-year period, leading to economies for using the shuttle system over ELVs.

Several major changes have happened since that time. First, the European Space Agency now has an ELV called Ariane (operated by a private company called Arianespace) which is competing very effectively with the shuttle, and it is alleged that the Europeans subsidize Ariane to maintain that competitive edge. Second, several U.S. companies decided that the shuttle had not proven its cost-effectiveness, and that customers would want to launch on U.S. ELVs instead of the shuttle, just as they might choose Ariane. Consequently, several companies are now trying to commercialize the ELVs which NASA has phased out. The Department of Transportation, which regulates these companies, has charged that NASA is subsidizing the shuttle to the detriment of this nascent commercial space business, and is trying to force NASA to raise its price. Third, the demand for shuttle launches is less than NASA had expected, principally because the total number of governmental, commercial, and foreign payloads that had been projected to be available have not materialized. Additionally, shuttle demand has been partially affected by some U.S. customers (including the Department of Defense) choosing to use selectively some ELVs rather than totally relying on the space shuttle. This reduced launch demand has resulted in pressure on NASA to charge more for each launch since there will be fewer launches per year. Lastly, in recent years, a broad group of companies (e.g., communications satellite builders and operators, upper-stage manufacturers, space platform owners and operators, and materials processing companies) have made sizeable investments in technology and hardware that are dependent on the shuttle. If shuttle prices increase dramatically, these ventures could fail.

One of the companies trying to commercialize a U.S. ELV (Transpace Carriers, Inc.) has filed a predatory pricing charge with the Office of the U.S. Trade Representative (USTR) against Arianespace (the company that launches Ariane) for subsidizing its launch vehicle. USTR is investigating the complaint, but informally Arianespace has responded that it will not stop subsidizing Ariane until NASA stops subsidizing the shuttle.

NASA was directed by the President to charge "full cost recovery" for launches beginning in FY89, and the agency has forwarded a plan calling for a price of $87 million plus or minus five percent (1982 dollars) for a dedicated shuttle launch from 1989-1991, compared to the current price (for the 1986-1988 time frame) of $71 million (1982 dollars).

Analysis

Some of the issues likely to be addressed by this Congress are: What does it actually cost NASA to provide a shuttle flight? What would be the impacts of various pricing levels on the U.S. ELV community and the various U.S. user communities? What are the likely pricing policy and capacity expansion actions that may be taken by foreign competitors? And what shuttle pricing policy best brings into balance all of these various considerations?

SPACE STATION PROGRAM

Issue

The space station program undoubtedly will receive more attention in the 99th Congress, including issues such as the role of man versus machine, initial operational capability (IOC) date, type of power supply, and DOD's role.

Background

In January 1984, President Reagan directed NASA to build a permanent manned space station within a decade. This announcement came after several years of lobbying by NASA for permission to proceed with a space station as the "next logical step" in the U.S. space program. During those years, NASA, together with the Department of Defense (DOD), contracted with eight major aerospace companies for "mission analysis studies" (MAS) to determine what missions could best be accomplished on a space station. DOD concluded that it had no need for a permanent manned space station for the foreseeable future, and is not participating in funding space station development.

Reaction to the space station decision has been mixed. Some space scientists are gravely concerned that, with another expensive manned space program to fund, NASA will not be able to support other space science programs. Although prominent space science groups, such as the National Academy of Sciences Space Science Board, recognize that a space station would be useful for many experiments, they argue that it is not required for most of those experiments, and they would be able to perform more missions using unmanned spacecraft which cost less. There is also criticism that NASA did not fully explore the potential of automated systems on the space station and automated platforms tended by the space shuttle instead of a manned space station. NASA supporters are enthusiastic about the decision both because it gives NASA a major focus for the next several years to maintain the vitality of the agency, and because they feel it will retain U.S. preeminence in space and space technology.

NASA has adopted a reference configuration for the space station, which includes one manned and two unmanned platforms with an IOC of 1992-3, although budget considerations may result in a stretching out of the program. The current plan calls for the continued use of solar arrays for power supply, although greater amounts of power probably will be required in the future, possibly leading to the use of nuclear reactors.

Analysis

The 98th Congress directed NASA to look more closely at the automated aspects of a space station program and to assess the possibility of phasing in a manned presence over a period of several years, rather than beginning with a permanent manned space station. The proper mix of "man and machines" in space has been a growing issue over the past several years and will likely become a focus of attention in NASA programs over the next several years. The possibility of extending the duration of the space shuttle so that it can remain in orbit for 30 days or more to accomplish those scientific tasks that cannot be performed on unmanned platforms may also be more thoroughly investigated.

Safety issues regarding nuclear power for use in space may also be quite controversial considering the difficulties that the Soviet Union has encountered in using such systems, and general concern by the public over nuclear power. Only the Soviet Union currently uses nuclear reactors in space.

ORBITAL MANEUVERING AND TRANSFER VEHICLES

Issue

Although the space shuttle is extremely useful for taking cargo from the Earth into low Earth orbit, its ability to transfer cargo from one orbit to another is severely limited. The development of orbital maneuvering vehicles and orbital transfer vehicles will probably be required for on-orbit operations.

Background

When the space shuttle was first conceived, it was part of a "space transportation system" which included a number of elements in addition to the orbiter and its solid rocket boosters and external tank. One part of the system was to have been a reusable "space tug" capable of taking payloads into higher orbits than those directly accessible by the shuttle. The space tug concept was indefinitely deferred as NASA's budget tightened and space shuttle overruns consumed a large part of the shuttle budget. Another possibility was the "Teleoperator Maneuvering System" (TMS) for moving cargo to different places at approximately the same altitude. This concept has also been indefinitely postponed.

Today, two different concepts are being discussed as offshoots of the TMS and space tug ideas. The orbital maneuvering vehicle (OMV) would be used to ferry payloads around in orbits close to the shuttle, while orbital transfer vehicles (OTVs) would be used to travel between orbits with greater variation (for example, between low Earth orbit and geostationary orbit and perhaps someday between Earth orbit and the Moon). Both vehicles would be reusable, unlike the upper stages used today to boost satellites into geostationary orbit, and could be used to retrieve as well as deploy payloads.

The need for OMVs will become more pronounced as the space station is being readied, since it will be assembled in orbit and devices will be required to take sections of the station from the shuttle to the final location of the station. OTVs will also be useful for taking payloads to geostationary orbit, instead of relying on expendable upper stages and apogee or perigee kick motors, which can fail (three failed in 1983, for example, leaving the satellites in unusable orbits, although two were later retrieved by the STS-51-A shuttle crew).

Analysis

The budget constraints imposed upon NASA since the 1970s caused a number of programs to be deferred. With development of the space shuttle now completed, it may be time to consider some of the programs that were affected. Among the many programs which are candidates for reconsideration are those concerned with moving cargo in orbit either to different locations at approximately the same altitude, or to higher and lower orbits. In the space station era, such vehicles are seen as necessary adjuncts to the space shuttle for servicing the station and associated unmanned platforms. Issues include whether or not these vehicles need to have crews or should be automated, whether they should be permanently based in space or on the ground, and the type of fuel to be used (cryogenic, storable, or solar powered). NASA has awarded two contracts to study OTV Options.

COMMERCIALIZATION OF SPACE

Issue

The prospects of commercial space activities, both in terms of private companies operating transportation systems to earth orbit and operating facilities in space, has opened a plethora of issues, including the proper Government role in this activity and the most advantageous Government organization for facilitating its work. Other issues include whether high insurance rates will deter companies from moving into the space business, and if the Government should become an "insurer of last resort."

Background

The role of the National Aeronautics and Space Administration (NASA) in commercializing space activities remains in question as other Government agencies, notably the Departments of Transportation (DOT) and Commerce (DOC), increase their jurisdiction over commercial space activities. NASA is an R&D agency, and, as space projects have taken on a commercial character, they have been transferred to the private sector (in the case of communications satellites) or other Government agencies (weather and land remote sensing satellites to DOC; expendable launch vehicles to DOT). Still, there are commercial space activities, such as materials processing in space (MPS), which are in earlier stages of development and in which NASA might still play a role both as stimulator to the private sector, and in performing R&D which would allow companies to ascertain the best areas to pursue for profit. NASA has several mechanisms, such as joint endeavor agreements (JEAs), for reducing the risk for companies wishing to enter the commercial space field, whether through production activities such as MPS, or through leasing facilities in space to NASA or other Government agencies or companies. The extent to which NASA will be able to continue providing assistance as more companies wish to take advantage of it may become an issue in the next several years, as will the amount of money NASA should spend on R&D in these areas when the private sector is the direct beneficiary of the research.

The potential effect of insurance rates on the ability of some companies (particularly small businesses) to participate in new endeavors is another issue. There are different forms of insurance which companies engaging in commercial space activities might require, including liability insurance and payload insurance. Recent losses in the communications satellite area caused several insurance underwriters to drop out of the space insurance field, and there is concern that the rates for insurance premiums may rise so rapidly that some companies may not be able to afford the insurance they require.

Analysis

The proper role of Government in R&D has been a long-standing issue in a number of fields, including space. It seems likely that if the Government does not perform a significant degree of fundamental R&D, companies will not be willing to invest in space because the risk will be too high. Similarly, high insurance rates could deter private sector involvement in space activities, especially new, innovative areas such as MPS where risks, and therefore insurance rates, may be high. If Congress wishes to facilitate the commercialization of space, it may wish to assert its support of these activities and to consider having the Government serve as an insurer of last resort for companies unable to afford commercial insurance. Those who have substantial reservations about hasty space commercialization may wish to oppose such subsidies.

ADVANCED REMOTE SENSING TECHNOLOGIES

Issue

The need for NASA to continue remote sensing research and development, once Landsat is transferred to the private sector, may be an important issue in the 99th Congress. NASA recently terminated research and development of the multi-linear array (MLA) sensor technology, despite industry and congressional support for the program.

Background

NASA developed Landsat as an experimental land remote sensing program. The Landsat system is now considered operational and is under the management of the Department of Commerce. Landsat is scheduled to be turned over to the private sector, which will be responsible for building and launching the next generation of satellites. Congress passed P.L. 98-365, which states under Title 5, Section 501:

> In order to preserve the worldwide leadership of the United States in remote sensing technologies and applications, the Administrator of the National Aeronautics and Space Administration is--(1) directed to continue and to enhance remote sensing technologies and is encouraged to conduct experimental remote sensing programs and to develop remote sensing technologies in support of its mission; . . .

Eosat was chosen to negotiate a contract for the Landsat system and follow-on satellites. Eosat had originally planned that the next generation Landsat would carry an advanced sensor, the multi-linear array, which was under development by NASA. The MLA program, although included in NASA's FY85 budget request, was cut by NASA from its operating budget. Eosat agreed to change the terms of the agreement, although the final contract has not been signed. (Further details on Landsat commercialization are discussed separately under COMMERCIALIZATION OF LANDSAT.)

Analysis

NASA's role in maintaining research and development in programs that have become operational is a continuing area of controversy. Some argue that it is in the national interest for NASA to support research and development in remote sensing technologies in order to maintain U.S. technological leadership and commercial competitiveness with other countries. The private sector seems unwilling to take on the cost and risk of developing that technology, at least until the data market is better established. However, the question remains, who should decide what research should be conducted? NASA's interest in remote sensing technology may not be the area that the private sector expects to be the most commercially profitable. Congress may find it useful to monitor both NASA's and industries' needs and programs.

France will be launching its own land remote sensing satellite in October 1985, with capabilities in some ways more advanced than Landsat technology. The United States faces the probability of a challenge to its market by foreign competition at a time when its system is most vulnerable, during the transfer of the system to the private sector.

COMMERCIALIZATION OF LANDSAT

Issue

The operation of Landsat and the development of a follow-on system may be contracted to the private sector in the near future. Congress will probably continue its oversight to ensure that the system is operated efficiently and competitively.

Background

The National Aeronautics and Space Administration developed Landsat, a land remote sensing satellite system, as an experimental research and development program. The first satellite was launched in 1972 and the fifth and final satellite was launched in March 1984. In 1979, President Carter began the process of moving Landsat to the private sector when he directed that Landsat become operational and that program management be moved to the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce. President Reagan accelerated the commercialization process and, in January 1984, released a Request for Proposals (RPF) to solicit bids from the private sector to operate Landsat 5 and to develop a follow-on system. Eosat, a Hughes-RCA joint venture, emerged as the final choice, although the contract has been held up by the Office of Management and Budget (OMB), which has not approved $75 million requested for FY85, part of the $250 million Government subsidy expected.

While the Federal Government conducted the RFP process, Congress developed its own guidelines for Landsat commercialization, resulting in legislation (H.R. 5155, which became P.L. 98-365 on July 1984). The legislation, which is basically consistent with the RFP, provides for licensing of all future remote sensing systems as well as non-discriminatory access to data.

Analysis

Lack of long-range commitment to an operational system has limited the utility of Landsat data. Some potential users have been reluctant to invest in computers and software until they are assured of a continuous flow of data. However, the Government contends that only the private sector is capable of developing a market for the data. The private sector, through the bidding process, asked for a higher level of Government subsidy than OMB was willing to support. A compromise may have been reached between Eosat and the Government, although the success of the venture will be determined in the future.

Even if the Government signs the contract with Eosat in the near future, Eosat will require four years, or until 1989, to build a follow-on satellite. Landsat 5, however, is expected to operate through 1988, resulting in a one-year data gap. If the Government does not sign the contract with Eosat, there will have to be a recompetition, adding more time between the current satellite and a follow-on.

France is planning to launch its own system, SPOT, in October 1985, and other countries are planning their own systems as well. The United States will find its market challenged by international competition. The continued Government role in remote sensing R&D, to maintain the U.S. technological lead, is also of concern, and discussed under a separate heading (ADVANCED REMOTE SENSING TECHNOLOGIES.)

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WEATHER SATELLITES

Issue

During the summer of 1984, a polar orbiting weather satellite (NOAA-8) and a geostationary weather satellite (GOES-5) failed, leaving the United States with only one of each type of weather satellite functioning. There are some indications that satellite lifetimes were over-estimated or that the program may have been under-funded. The 99th Congress may consider steps to ensure that the system is restored to full capacity as soon as possible, and to prevent future failures.

Background

The United States weather satellite system has traditionally included four satellites: two geostationary satellites, called GOES (one providing west coast data and one providing east coast data), and two polar orbiting satellites called NOAA. Each provides different data for different services. GOES satellites provide constant monitoring of Western Hemisphere weather conditions, which is particularly useful for monitoring hurricanes and severe storms which might reach U.S. coastal regions. NOAA satellites provide full world coverage. Under the Reagan Administration, there have been several attempts to go to a one-polar-orbiting satellite system (plus the two GOES satellites). During each budget cycle, Congress has added funding for the second polar satellite, in part because of a perceived need for an in-orbit spare.

In July 1984, the GOES-East satellite failed. GOES-West was then moved to a more central position, where, with some maneuvering, it could provide storm data for both the east and west coasts. NOAA-8 also failed in July 1984. An out-of-service satellite, NOAA-6, was reactivated to replace NOAA-8, providing morning coverage. NOAA-9 was launched in December 1984, but replaced NOAA-7, providing afternoon coverage, which is considered more important for forecasting. The next NOAA launch, planned for late spring 1985, will replace NOAA-6.

Analysis

The earliest possible GOES launch is expected in winter 1985-1986. The United States will have only one geostationary weather satellite until that launch. According to NOAA planning, GOES satellites have a four- to five-year lifetime, despite the fact that most GOES satellites have lasted only three years. The question then arises as to whether NOAA should have anticipated the recent failure and whether satellite procurements have been slowed in favor of budget savings. Congress may also want to monitor future GOES procurements to minimize future shortfalls in delivery and operational satellite lifetimes.

With next spring's NOAA launch, the United States will resume a two-polar-weather satellite system. Again, the question may be raised of whether one polar satellite provides sufficient coverage. The recent failure and replacement of the NOAA satellite may provide added incentive for maintaining a two-satellite system. Also under consideration is the possibility of an internationally-funded second polar orbiter.

INTERNATIONAL SPACE ACTIVITIES

Issue

Space activities of other countries, both as competition to the United States and as potential partners in cooperative space activities, are of increasing interest as more countries develop indigenous launch capabilities and expand their interest in using and exploring space.

Background

Although most people are only aware of the space activities of the United States and the Soviet Union, in fact virtually every country in the world uses space systems for applications such as communications, weather forecasting, and remote sensing, and three other countries (China, India, and Japan) and one internationl organization (the European Space Agency--ESA) have developed their own launch capabilities and build their own satellites. Many countries also participate in international space projects sponsored by the United States or Soviet Union, and representatives of 11 countries other than the United States and the Soviet Union have now flown in space courtesy of those two space superpowers. Space has truly become internationalized.

The United States has been intensely involved in encouraging other countries to participate in its space activities since NASA was created in 1958, and has concluded more than 1000 agreements with more than 100 countries during that period of time. International cooperation is especially important in sharing the costs associated with expensive space projects.

While a great many countries are anxious to cooperate in U.S. space programs, including the space station program, there is a growing wariness on the part of some (particularly European countries) because of problems that have developed. In particular, the U.S. decision to unilaterally withdraw from a joint project with ESA to send two probes to the Sun, because of budget constraints, created discord. ESA, which developed the Spacelab module which flies in the shuttle cargo bay as part of an agreement with the United States, is unhappy with that program, stating that, for all the expense they put into the Spacelab, they have gotten little in return.

International competition is a growing area of concern, too. ESA has successfully attracted many payloads to its Ariane vehicle (now operated by a private company, Arianespace) which NASA had hoped to fly on the space shuttle. Many factors play a role in convincing a company to choose Ariane over the shuttle, only one of which is the launch price. Others include the payment schedule (NASA requires payment before the launch whereas Arianespace permits more flexibility and can defer the major part of the payment until after the satellite is in orbit and producing revenue), insurance rates, and so on.

Analysis

Countries engaged in cooperative space programs with the United States may require more binding agreements in the future, perhaps treaties, to ensure that the United States lives up to its obligations. The United States might, therefore, be required to consider approval of a project through to its completion, unlike the current situation where each space project is subject to annual review. It may be desirable to provide NASA more flexibility in marketing the shuttle, or turn shuttle marketing over to private industry, to ensure its competitiveness with Ariane. To encourage other countries to participate in space programs it may be useful to allow them more involvement in programs starting at the earliest stages, perhaps best expressed as "collaboration" instead of "cooperation."

16. TECHNOLOGICAL INNOVATION, INDUSTRIAL R&D, AND TECHNOLOGY TRANSFER

See also item:

14.3 THE IMPACT OF SOCIAL SCIENCE RESEARCH ON INDUSTRIAL PROCESSES

ROLE OF THE FEDERAL GOVERNMENT IN THE COMMERCIALIZATION OF FEDERALLY-FUNDED RESEARCH AND DEVELOPMENT

Issue

The Federal Government spends approximately $44.5 billion (FY84 est.) for R&D. At issue is what mechanisms have been, and can be, or should be developed to encourage the commercialization of federally-funded R&D so that appropriate technologies are brought to the marketplace where they can contribute to the economic and technological growth of the United States.

Background

In pursuit of their missions, Federal departments and agencies fund and perform research and development which has resulted in many new products and processes. However, Federal units generally lack the authority and/or ability to further develop, adapt, and commercialize the results of the R&D endeavor. Thus, most of these technologies do not reach the marketplace.

Several recent laws have attempted to encourage commercialization of federally-financed R&D. Section 11 of the Stevenson-Wydler Technology Innovation Act (P.L. 96-480) mandates technology transfer as a mission requirement of the Federal R&D agencies and creates various mechanisms to encourage the transfer of technology to the private sector. The Patent and Trademark Amendments of 1980 (P.L. 96-517) allows small businesses, not-for-profit institutions, and universities to retain title to inventions made under Federal funding based on the rationale that companies with title to inventions are most likely to see the effort through to commercialization. Title V, "Government Research and Development Patent Policy," of P.L. 98-620 also makes several amendments to the patent laws which should improve the transfer of technology to the private sector. Among other initiatives, this law permits Federal laboratories to make decisions concerning patent licensing, allows a certain portion of royalties to revert back to the laboratory, and permits private companies, regardless of size, to obtain exclusive license for the life of the patent.

Analysis

Given the large amount of money and time expended on the Federal R&D effort, it seems desirable to expand the return on the Nation's investment. Commercialization of technology by industry and small businesses brings new products and processes into the marketplace to meet both public and private demands. This creates employment opportunities and contributes to U.S. economic growth. It also may provide solutions to the increasing number of technologically-oriented problems. The present concern for the Nation's technological leadership may encourage further consideration of the promotion of commercialization of technologies developed within the Federal laboratory system.

The Stevenson-Wydler Technology Innovation Act mandates that " . . . the Federal Government shall strive where appropriate to transfer federally owned or originated technology . . . to the private sector." To accomplish this, each Federal laboratory is required to establish an Office of Research and Technology Application. A Center for the Utilization of Federal Technology is mandated to coordinate the transfer effort; this organization has been created under the National Technical Information Service of the Department of Commerce. The extent to which the agencies are complying with the letter and intent of the law remains to be assessed. Since P.L. 96-480 is up for reauthorization in the 99th Congress, there is the opportunity to determine if changes should be made to increase the commercialization of the results of the Federal R&D enterprise.

Federal patent policy has been criticized as one barrier to the commercialization of federally-financed R&D. Because Government patents have been available to anyone through licensing procedures, business is often hesitant to invest when the uniqueness of the technology cannot be assured. P.L. 96-517 addresses this issue and permits small businesses, universities, and not-for-profits to retain title to inventions made with Federal financing. P.L. 98-620 both encourages laboratories to promote the transfer of technology from the laboratory to the private sector and encourages industry to utilize Federal technology, making it easier to obtain exclusive license. Efforts continue in Congress to legislate a uniform Federal patent policy and to give all contractors, regardless of size, title to inventions they made under Federal funding.

IMPLEMENTATION AND REAUTHORIZATION OF THE STEVENSON-WYDLER TECHNOLOGY INNOVATION ACT

Issue

The Stevenson-Wydler Technology Innovation Act (P.L. 96-480) mandates several activities designed to encourage industrial innovation to promote economic growth. The Act is up for reauthorization in the 99th Congress. At issue is how the provisions of the legislation are being implemented in the executive branch and the extent of their impact on the national economy.

Background

Concern over what was perceived as the Nation's declining innovative capacity and decreasing productivity and rate of economic growth led to the passage of the Stevenson-Wydler Technology Innovation Act. Incorporating several initiatives outlined by former President Carter in his Industrial Innovation Message of October 1979 and mandating several new activities, the law is designed to promote technological innovation for the achievement of U.S. economic, environmental, and social goals. This is to be achieved by: the creation of organizations within the executive branch to study and stimulate technological innovation, including the Office of Productivity, Technology, and Innovation in the Department of Commerce; the promotion of innovation and development through the establishment of cooperative centers for generic technology; the improved utilization of federally-funded R&D by both State and local governments and the private sector; and the institution of exchange programs between scientific and technical personnel in universities, industries, and the Federal laboratories.

Analysis

Implementation of the provisions of the Stevenson-Wydler Act appears to vary according to the section under consideration. While the Office of Productivity, Technology, and Innovation (OPTI) has been created and is operating, (although OMB has suggested eliminating the Office) there has been no funding for the generic technology centers program. Instead of these centers, OPTI is providing information to businesses on productivity and innovation, and is attempting to act as a broker between industry and academia to encourage, but not fund, interaction between these sectors. The office is promoting utilization of the R&D tax credit and recent changes in the antitrust laws as they pertain to joint R&D ventures to accomplish some of the goals of P.L. 96-480. In addition, OPTI is encouraging the use of R&D limited partnerships to finance research and development without direct Government spending. Congress may want to assess whether or not these activities undertaken by the Department of Commerce meet both the letter and intent of the law as enacted.

Section 11 of the Stevenson-Wydler Act establishes a system within the Federal Government to facilitate the transfer of the results of federally-funded R&D to State and local governments and to industry. To this end, Offices of Research and Technology Applications are to be created in each Federal laboratory to identify technologies and ideas with potential application in the State and local arena as well as in the private sector. Most agencies appear to have complied with this provision. However, the Center for the Utilization of Federal Technology (CUFT), which was created to serve as a focal point for this transfer network, may not be as effective as was originally intended. Thus, Congress may want to investigate whether or not the mechanisms created by the Stevenson-Wydler Act to transfer technology have been optimally implemented, and whether alterations could make the system more effective.

IMPLEMENTATION OF THE SMALL BUSINESS INNOVATION DEVELOPMENT ACT

Issue

Small businesses have contributed substantially to the economic growth of the United States. In an attempt to encourage innovation in the small business sector, Congress enacted P.L. 97-219, the Small Business Innovation Development Act. This law is designed to increase the amount of Federal research and development funds allocated to small firms. At issue is whether the program created by P.L. 97-219 has served to increase innovative activities in the small business community and what impacts, if any, there have been on the overall Federal R&D effort.

Background

P.L. 97-219 attempts to increase small business participation in Federal R&D through the creation of a Small Business Innovation Research (SBIR) program in each relevant Federal agency. This program consists of a three-phase activity which, in addition to providing support for research, also encourages the pursuit of commercial application of these endeavors. This initiative is funded by a mandatory set-aside which is a fixed percentage of that agency's research and development budget. The SBIR program is based upon the assumption that, because of the highly innovative character of many small firms, the small business sector should receive a greater share of Federal R&D if increased innovation is desirable.

Analysis

There have been several rounds of solicitation for the SBIR programs in the various agencies resulting in some indications as to their initial impact. Several concerns were expressed during congressional consideration of the proposal which might be addressed now that the program is operational. The set-aside concept is one which has many critics. It has been argued that a set-aside distorts the traditional relationship between the public and private sectors and interferes with the normal efficiency of the marketplace. It also has been asserted that the set-aside mechanism circumvents the congressional budget process which is used to determine program priorities and budget allocations. Of interest is how the current SBIR efforts, measure up in light of these reservations.

Additional concerns have been raised as to the extent of the R&D capacity within the small business sector. What needs to be determined is if small firms have been able to provide the amount of technical and scientific knowledge required by the increased percentage of research and development funding and which meets the needs of the Federal agencies. Questions also remain as to what impact the SBIR program has had on other Federal R&D efforts, including the funding of basic research in universities.

Federal funding for research and development is of major importance to the Nation's technological development and economic growth. Measures which alter the funding process may have significant impact on the innovative capacity of the United States. Thus, the Congress may want to assess the impact of P.L. 97-219 on the Federal R&D establishment, on industrial innovation, on innovative activities in the small business sector, on university research, and on the general economic position of the United States.

INDUSTRY-UNIVERSITY-GOVERNMENT COOPERATION IN INDUSTRIAL INNOVATION

Issue

Industry-university cooperation in technological development is one mechanism intended to increase innovation. Because universities traditionally perform basic research, but do not have the commercialization capacity that industry possesses, efforts to foster increased interaction between these two sectors have been made to augment the potential for the development of new products and processes. At issue is the proper role of the Federal Government in building the linkages between universities and industry.

Background

Universities play a pivotal role in the Nation's R&D enterprise. They educate the scientists, engineers, and managers employed in industry. They also perform much of the basic research that industry utilizes to develop commercially viable products and processes. The relationship between these two sectors has weakened over recent years, especially as the Federal Government has replaced the private sector as the major source of funds to support university research. The focus on training students to solve industry-related problems has been lost to a significant extent.

The Congress has enacted several laws which are designed to strengthen industry-university interaction. The Stevenson-Wydler Technology Innovation Act (P.L. 96-470) authorized the creation of cooperative generic technology centers which, while not limited to universities, would have established a means for industry and academia to work together in technology development. These centers never were funded. A similar idea was embodied in the Manufacturing Technologies bill which was passed by the 98th Congress. The President, however, vetoed the bill. An alternative approach, supported by the Reagan Administration, is that contained in the Economic Recovery Tax Act, (P.L. 97-34). Title II provides, in part, a 25 percent tax credit for 65 percent of all company payments to universities for the performance of basic research. Businesses also are permitted a larger deduction for charitable contributions of equipment used in scientific research in universities.

Analysis

As industry and universities attempt to forge a closer relationship aimed at increasing innovation, it remains to be determined what role, if any, the Federal Government should play in fostering interaction between business and academia. State governments currently are developing and supporting programs within States to accomplish this objective. The Federal Government may choose to assess the impact of State efforts and determine if there are activities on a Federal level which can augment on-going programs.

There have been several precedents for Federal involvement in encouraging industry-university interaction as discussed above. In addition, a program at the National Science Foundation has demonstrated that, in given circumstances, the Federal Government can act as a catalyst for such cooperation and can develop programs which do not require continual Federal funding, but which subsequently are supported by industry.

An analysis of the results of the R&D tax credit might help in the determination of the Federal role in this issue. Other questions still remain as to whether Federal policies aimed at improving the economy as a whole or policies to stimulate innovation directly are more effective.

INDUSTRIAL RESEARCH AND DEVELOPMENT IN THE UNITED STATES

Issue

What are the implications for Federal science and technology policy of current trends in the level and the nature of industrial research and development spending, both that supported by company funds and that supported by the Government?

Background

Established patterns of industrial R&D are changing as Federal R&D priorities evolve, as industrial R&D moves overseas, as the relationships between university and industrial research are strengthened, and as small firms join large enterprises as important contributors to industrial innovation.

Since 1977, industry has spent more of its own funds on R&D than the Federal Government has spent. When combined with the fact that over one-half of all Federal R&D is performed in industry, this means that nearly three-fourths of the Nation's R&D is performed in industrial laboratories. Furthermore, the Nation depends on industry for converting the results of this R&D into products, processes, systems, and services that will be useful for national defense, for economic growth and industrial competitiveness, and to meet human needs with respect to health, well-being, and the quality of life. In view of the growing importance of technology as a strategic element in the international competitiveness of U.S. industry, some have asked whether current Federal R&D programs and priorities are optimal.

Analysis

Many Federal policies and programs affect industrial R&D. These include tax incentives for R&D and for investment in plant and equipment, technical education support, antitrust and patent policy, and the direct support of R&D in industry and universities. The 96th to 98th Congresses changed several of these policies in order to encourage industrial R&D and innovation. Some, such as the Stevenson-Wydler Technology Innovation Act of 1980 and the incremental R&D tax credits of 1981, will be considered for reauthorization, while oversight hearings may be timely for others, such as the Small Business Innovation Development Act. A broad-based examination of industrial R&D in the United States would provide a foundation of understanding within which to address each of these particular concerns, and would also be complementary to the studies of the Science Policy Task Force, which are focused more heavily on the government-university partnership.

It is essential to the Nation's strength that the industrial R&D enterprise remain healthy and competitive. Congress may wish to systematically assess the variety of public policies that affect the rate, nature, and direction of industrial R&D and of the technological innovation that flows from it. As a first step in such an assessment, it would be useful to understand by whom, and how well, industrial R&D in the United States is being performed. Subsequently, the effectiveness and other consequences of Federal industrial R&D policies might be reexamined in order to determine whether there is a need for modification of existing programs or the development of new ones to assist industrial R&D, either through direct funding and provision of services or through additional adjustments in the environment for industrial innovation.

INNOVATION, GROWTH, AND INTERNATIONAL COMPETITIVENESS

Issue

Since the late 1970s, a worsening U.S. merchandise trade balance in general and a shrinking U.S. surplus in high-technology trade in particular have raised fears that the international competitiveness of U.S. industry is in decline. These fears in turn have focused renewed attention on the domestic climate for industrial innovation. Innovation plays a vital role in long-term industrial growth and competitiveness--a role that is extremely difficult to measure. Some analysts and policymakers have called for a more active Federal role in the domestic innovation climate. Others suggest that this climate would benefit from less Federal intervention.

Background

The concern about the ability of U.S. manufacturing industries to compete successfully in world markets has its roots in a number of seemingly adverse trends in the international economic performance of the United States. The U.S. merchandise trade balance has been in the red since 1975, and the deficit exceeded $100 billion in 1984. Imports have captured increasing shares of the domestic market for steel, copper, automobiles, apparel, consumer electronics, footwear, chemicals, machine tools, semiconductors, and general aviation aircraft--to cite the most prominent examples--since the late 1970s. The U.S. trade balance in high-technology goods (such as aircraft, semiconductors, computers, drugs, scientific instruments, and telecommunications equipment) with Japan and the newly industrialized nations of East Asia has been increasingly negative since 1980. U.S. growth in manufacturing productivity lagged far behind that of Japan, West Germany, Great Britain, France, and Italy between 1977 and 1982. U.S. manufacturing productivity growth has increased considerably since the end of the 1981-1982 recession. The rate was 4.3 percent in 1983 and 4.6 percent in 1984. Since 1964 the United States has devoted a smaller share of its Gross National Product (GNP) to industrial research and development than its two biggest rivals in world high-technology markets, West Germany and Japan. If defense-related R&D is included, however, the United States leads is rivals by wide margins.

Innovation refers to the process of product and process creation. It plays a vital role in the growth and competitiveness of companies, industries, and nations because new products or processes expand or improve existing product lines or services and lower cost structures. Yet innovation is an intractably uncertain and complicated process. There seldom seems to be a clear and direct path from the drawing board to the marketplace; the risks associated with investment in innovation--measured by industrial R&D spending--are inordinately high; and the return on this investment often is difficult to appropriate. These features make it difficult to design policies to improve a nation's innovation climate. Studies have shown that a nation's rate of innovation over time is closely related to spending on new plant and equipment and R&D.

Analysis

The 99th Congress may wish to consider certain changes in the mix of policies shaping the domestic innovation climate. One issue that is likely to be debated is renewal of the existing tax credit for R&D; the major questions to be addressed are how much of a stimulus the credit has imparted to domestic R&D spending and whether or not the credit should be extended, liberalized, or made permanent. Another issue that is likely to receive attention is trade reciprocity, or legislation intended to assure U.S. sellers the same access to their rivals' markets that their rivals have in the United States. A perennial complaint of many U.S. computer and semiconductor firms is that they do not have the same access to Japanese markets and research facilities as their Japanese competitors enjoy here. Finally, there is the issue of macroeconomic policy. Any legislation that puts downward pressure on interest rates and causes the dollar to depreciate against the currencies of the major trading partners of the United States would aid the domestic climate for industrial innovation and U.S. international competitiveness.

17. UNIVERSITY RESEARCH

See also items:

1.4 R&D FUNDING SUPPORT MECHANISMS

16.4 INDUSTRY-UNIVERSITY-GOVERNMENT COOPERATION IN INDUSTRIAL INNOVATION

CHANGES IN SUPPORT OF UNIVERSITY RESEARCH

Issue

Can U.S. universities maintain their freedom and integrity of scientific inquiry in the face of challenges posed by increased funding from U.S. industry and defense agencies?

Background

Over the last few years, industry and defense agencies have begun to provide increasingly larger amounts of funding for university R&D. In the late 1960s, the Defense Department was the source of almost 20 percent of Federal R&D to universities. This fraction began to level off in 1967, and reached an average annual low of about nine percent during the period 1974 to 1977. Such funding began to increase, to about 11 percent for a few years, but significantly larger and more rapid increases were made during the period 1981 to 1985, when the DOD funding increased from 13 to 16 percent.

The most recent NSF data that are available to describe industrial support to universities show that it rose from about 3.3 percent of the total received by universities in 1975, to about 4.5 percent in 1982. NSF projects that total industrial R&D funding will increase about 38 percent from 1982 to 1985. It is likely that industrial support for university research will increase commensurately.

University researchers appear eager to obtain industrial support, in part because of recent trends in Federal civilian and defense funding to universities. Federal R&D funding has increased 65 percent since 1980, while Federal non-defense funding to universities has increased 36 percent over that period. Despite the benefits afforded by increased industrial support, these shifts, in some respects, circumscribe the freedom of scientific inquiry at universities. Much industrial funding occurs via contract; researchers, therefore, are less free to chose to do creative basic research and more likely to do research which conforms to the immediate, applied, and profit-oriented research needs of industry. Thus, traditional academic teaching, research, and administration may be reduced. In some cases, freedom of publication and communication of scientific information must meet the requirements of patenting and resulting control on the flows of proprietary information. In addition, questions have been raised about the potential conflicts of interest and ethics of using students for commercial ventures.

The National Academy of Sciences established a "Government-University-Industry Roundtable" to assess the short- and long-range implications of these new relationships for the future of American science. The Association of American Universities established a Clearinghouse on Corporate/Academic ties to monitor the propriety and integrity of these arrangements. The passage of the Patent and Trademark Amendments of 1980 (P.L. 96-517) has enhanced industrial-university interactions, since it gives universities the right to patent and license for sale intellectual property developed with Federal funds. Many States are trying to induce additional industrial support with tax incentives and land-grants for industrial parks located near universities.

Enlarged defense support of university research has increased the amount of classified work at research centers affiliated with universities and may involve mainstream academic faculty in classified research. This will occur, for instance, in the DOD's funding, totaling about $100 million, for the creation of the Software Engineering Institute at Carnegie-Mellon University. Another issue was described in a recent report, Federal Restrictions on the Free Flow of Academic Information and Ideas, prepared by Harvard University in November 1984. Reportedly, the Defense Department has attempted to control prepublication of nonclassifiified, but so-called "sensitive", university-research funded by the Government, and other agencies have attempted to modify research findings.

Analysis

The Committee may wish to consider the benefits and costs to universities that accompany increased industrial research funding. This may be appropriate when considering extension of the provisions of the Economic Recovery Tax Act of 1981, which give tax incentives for industrial funding of university research. The Committee may also want to follow the work of the National Academy of Sciences to assess the implications of industrial and defense funding on the future of American science and to examine the need to strike a balance between the conduct of science relevant to national security and maintaining traditions of freedom and objectivity. Additional legislative attention might consider the appropriateness of proposed DOD restrictions on prepublication review of nonclassified research, the increasing restriction of foreign scholars at American universities, and the ultimate capacity of American universities to provide resources to meet the knowledge needs of both defense and non-defense science and technology.

UNIVERSITY RESEARCH INFRASTRUCTURE

Issue

Many leaders in government, industry, and universities assert that research facilities and instrumentation of the Nation's leading universities are becoming seriously obsolete. The inability of universities to conduct research on the frontiers of science for lack of modern facilities may pose serious consequences for science and engineering in this country and for the Nation's primary users of research and advanced training--government, industry, and universities themselves.

Background

Research facilities are the actual buildings (they could include mobile or remote spaces, such as ships, airplanes, aquaculture facilities, and monitoring stations) which house and support academic research and research instrumentation. The combination of research facilities and the supporting instrumentation is commonly referred to as the university research infrastructure. Historically, the Federal Government has assumed a major role in funding research facilities at higher educational institutions. The launching of Sputnik in 1957 unleashed a burst of Federal research and development funding, including support for the development of university research infrastructure in science and engineering. However, by the late 1960s and early 1970s, Federal and State funding for research facilities was reduced dramatically. For example, in 1965, the Federal Government provided about $126 million for research facilities on university campuses. By 1979, Federal support had declined to $32 million. It has been estimated by a witness at a hearing of the House Committee on Science and Technology that colleges and universities can finance, out of their own resources, no more than half the investment in the technological infrastructure needed to educate the scientists and engineers that the United States must have in the future. Recently, GAO reviewed five completed studies of university research equipment needs and reported that, although each study concluded that there is a substantial need for new equipment, none of these studies could be used to estimate the level of current need. GAO stated that the current NSF-supported Westat study may provide Congress with more reliable information on the current level of need.

Analysis

An earlier, preliminary NSF survey of 25 universities conservatively estimated that research universities and colleges require $1.3 billion per year to meet accumulated research facilities needs. In FY84, the total Federal investment in R&D plants in universities and colleges is projected to be $40 million. In the area of instrumentation, DOD has estimated that it could cost up to $2.0 billion to elevate university laboratories to "world class" status. Others contend that the cost will be closer to $4.0 billion. Although there is general agreement that the Nation's research infrastructure will require revitalization, one of the major concerns facing Congress is determining how serious the problem is and what role the Federal Government may wish to play in helping to revitalize the Nation's university research infrastructure.

ALTERNATIVES TO PEER REVIEW

Issue

Examination of the alternatives to peer review and the project grant mechanism for support of research in universities.

Background

One of the enduring issues in the support of research in universities is the determination of the roles to be played by scientists and engineers on the one hand, and the representatives of the public on the other. One resolution of this issue employed by several of the major agencies that support university research involves allocation of funds among fields of inquiry by the Government, with heavy dependence on the advice of scientists and engineers (peer review) in making decisions about the allocation of funds to specific projects and investigators.

The peer review process is founded on the assumption that the persons who are in the best position to judge the prospective merits of a proposed project are other investigators who are carrying on closely related research in the same or similar fields. It is believed that they can make the most reliable judgments about the importance of the proposed work, the probability of success, the adequacy of the research plan, the competence of the investigators and their institutions, and the degree to which the proposed studies are consonant with the state of scientific understanding.

Questions are raised about the adequacy, fairness, efficiency, and appropriateness of peer review as the basis for allocation of public resources to university research. Not all funding agencies use this method, nor do all non-Federal sources of university research funds. Some have asked whether peer review stifles creativity, expends too much time of reviewers and proposers, reinforces established patterns of support to elite institutions in certain regions, and inhibits interdisciplinary and problem-focused research. Recently, controversies have arisen when Congress allegedly infringed on the prerogatives of the technical community by appropriating funds for facilities at universities without first soliciting its views. With the growing acceptance of the view that regional economic development is enhanced by the presence of Federal support for science and engineering activities, it is expected that pressure for more such congressional decisions will continue.

Analysis

From time to time, Congress has examined the peer review system, primarily from the point of view of its fairness to marginal institutions and to new ideas. It may be an opportune time to examine this approach to research policy once again. It may be useful to examine whether recent experiments in NSF and elsewhere with block grants, local discretion for allocation of funds among grants, and the like have been successful. Similarly, it may be useful to examine the practices and successes of organizations and agencies that use other methods of allocation, such as the Naval Research Laboratory, the Minerals Management Service, and private foundations such as the MacArthur Foundation's well-known grants program for outstanding individuals.

UNIVERSITY-INDUSTRY RELAATIONS

Issue

What compromises do universities have to make when they become involved in joint research ventures (such as communications of results, ownership of findings, and use of foreign researchers)? What can the Federal Government do to ensure that university research facilities that are recipients of public funding are used for both public and private benefit?

Background

Cooperation between universities and industry is not new. Traditionally the universities primarily have been involved in conducting basic research, while industry took the results of that research and applied it to their particular commercial needs. However, beginning in the mid-1970s, with rapid scientific advancements the conventional distinction between applied and basic research became blurred. When universities began to experience economic pressures from rising operating costs, declining student enrollments, and declining Federal research and training support, greater private-sector support of research and training provided a potential avenue of renewed vitality. Further, growing Federal concern about the loss of United States competitiveness in high-technology areas resulted in congressional enactment of legislation, such as the Stevenson-Wydler Technology Innovation Act, to encourage more industry-university cooperation. Currently, universities and industy have been forging new relationships in high-technology research areas that have tremendous short-term commercial potential. For example, the market for industrial applications of genetic research is estimated to be $40 billion over the next few decades. Because competition in these areas is so intense and the potential economic pay-offs so large, many scientists believe that the universities that are recipients of public funds will have to compromise some of their fundamental research principles. For example, these arrangements could involve limiting the free inquiry and public dissemination of ideas and research findings in order to protect proprietary information. However, scientists who support greater university and industry cooperation contend that the universities are well aware of these problems and have initiated policies to resolve them.

Analysis

Although there are no set patterns to many of the existing university-industry cooperative agreements, each raises some common element of concern. One such concern is that private companies could make a modest investment in a joint university research venture, in which public funds have been used to build competence in a particular field, thus allowing industry to reap profits well beyond the scope of their initial investment. Congress may wish to consider whether such public monies have been, or may be, used to subsidize large corporate profits. Another concern of some scientists is that a large infusion of private funds into basic research for commercial profit may distort research priorities in certain academic fields. Congress may wish to determine whether such funding will result in a lack of support for those areas of basic research that do not appear to have immediate commercial pay-offs.

18. WEATHER, CLIMATE, AND EARTH SCIENCES

See also item:

15.9 WEATHER SATELLITES

ATMOSPHERE AND CLIMATE

Issue

In the past dozen years, the attention of atmospheric and oceanic scientists has increasingly turned to problems of climate, prompting a world-wide surge of research on the global climate system and the organization of coordinated national and international programs.

Background

Quantitative study of past climates has revealed the natural, long-term variability of climate, while the Sahel drought and the grain dislocations of the early 1970s, as well as the Ethiopian drought and the winter fuel shortages of recent note, are some examples of the human vulnerability to climatic extremes and fluctuations of a more transient nature. Numerical models and field measurements of, for example, the increasing atmospheric concentrations of carbon dioxide and some other radiatively active trace gases, have raised concerns that human actions might be producing changes in the composition of the atmosphere and altering Earth's climate. It was realized, however, that both predicting natural climatic variability, on whatever time scale, and assessing man-induced changes required, as prerequisites, first, a basic understanding of the elements of the global climate system comprising the world ocean, the land surface, the ice and snow masses, the biosphere, and the atmosphere and, second, the capability to construct coupled, dynamic models of these elements' interaction.

Analysis

Climate system research has established the need to describe the three-dimensional structure of the circulation of the world ocean, its seasonal variation, its interannual variability, and its interaction with the atmosphere. Such information is crucial to defining the role of the ocean in storing and transporting heat in the climate system, improving models of air/sea interaction, and validating climate simulation models. New technology for direct and remote sensing of the ocean's surface and subsurface has led ocean scientists to design an observational experiment known as the World Ocean Circulation Experiment (WOCE) as part of the World Climate Research Program. What is the nature and proposed extent of the U.S. commitment to WOCE? What level of investment would be needed for satellite-borne observing and communications capabilities to permit commencement of WOCE by the end of the decade?

Much attention has been focused on projected global warming due to increased atmospheric carbon dioxide. The corresponding effects of other radiatively active trace gases are additive to those of carbon dioxide, and these effects could be significant. Vertical profiles with latitudinal coverage for nitrogen oxides, ozone, some hydrocarbons, water vapor, and carbon monoxide, among others, could prove useful for validating models of the chemical composition and cycles of the global atmosphere. What field and laboratory measurement programs are under way or should be initiated to help provide a firmer basis for understanding and predicting the behavior of the trace gases that may influence climate?

A large and growing body of evidence suggests that the tropical ocean influences the global circulation of the atmosphere on time scales from a season to about two years. Analysis of this evidence reveals possibilities for predicting seasonal and interannual climate fluctuations. Currently, simple empirical methods based on this evidence are being applied to generate crude seasonal forecasts over North America. Further progress, according to scientists, will require a better understanding of the coupling processes between air and sea. A base for research exists in several Pacific-oriented air/sea programs completed, in progress, or already planned, which have U.S. national as well as international components. What is the nature and projected

extent of further U.S. commitment to any such national and international programs to study the interannual variability of the tropical ocean and global atmosphere? What are the prospects that this research and its application might enhance predictability of events in the seasonal to monthly time range? Which, if any, atmospheric events, circulation states, and circulation characteristics are more, or less, predictable than others?

THE NATIONAL STORM PROGRAM

Issue

The proposed STormscale Operational and Research Meteorology (STORM) program is an operational and research effort designed to enable weather services to observe and predict small-scale weather phenomena with improved accuracy and reliability. This contemplated Federal interagency program would require deployment of new observation and communication technologies and a program of supporting atmospheric research. Though congressional interest has been expressed in STORM and the President's Office of Science and Technology Policy has reacted favorably to this proposed effort, it is not clear that, in view of tight agency budgets, this program can be undertaken in the near future.

Background

Severe weather events such as thunderstorms, rain-induced flash floods, tornadoes, violent squall lines, and heavy local snows, as well as dense fog, freezing rain, and persistent temperature inversions, all of which affect small areas for limited times, cause extensive loss of life and property damage. An understanding of smaller-scale weather events is essential to improve capabilities for predicting these events. While there is close interrelation between large- and small-scale weather, changes and improvements to current observing, communications, and forecast dissemination systems are necessary to observe and analyze the small-scale events. Technology to improve these systems either currently exists or is in various stages of development.

STORM is a major operational and research program, proposed for the 1980s and 1990s, which is intended to enable public and private meteorologists to observe and predict small-scale weather phenomena with greater accuracy and improved timeliness, and apply improved predictive capability for protecting the public, serving the national economy, and meeting defense needs. STORM would involve at least seven Federal agencies as well as universities and private meteorologists. Though total costs for STORM have not been defined, it is estimated that about $100 million would be needed annually over the next decade, mostly for the operational program, the costs for research being about 15 percent of the total cost.

Analysis

The technical plan for STORM calls for extensive involvement of the National Oceanic and Atmospheric Administration (NOAA), as lead agency. Neither NOAA nor its parent Department of Commerce, however, has endorsed the program in view of current budget constraints, although currently there do not appear to be any substantive objectives to the program as envisioned. Meanwhile, some other agencies have planned for inclusion of funds to begin STORM while still others are waiting to see if the program gains support in NOAA. As a result of this funding uncertainty and lack of a definitive position within NOAA, it is unclear when and if STORM might be undertaken.

Resolutions were introduced during the 98th Congress in both House and Senate, and S. Con. Res. 109 was passed, expressing the sense of the Congress that the Federal Government should take immediate steps for funding a national STORM program. In view of past congressional interest in this program and its potential for improving weather service capabilities, the Committee may want to review plans of Federal agencies, particularly those of NOAA, for undertaking STORM. Some have proposed funding for this program through a congressional initiative rather than through the normal agency request processes.

THE NATIONAL WEATHER SERVICE: OPPORTUNITIES FOR IMPROVEMENT IN A TIME OF RETRENCHMENT

Issue

In recent years there has been concern over Administration proposals to reduce funding and personnel levels of the National Weather Service (NWS), to close and downgrade the status of NWS Weather Service Offices, to reduce or eliminate specialized services provided by NWS, and to contract out certain weather service functions. These attempts at retrenchment are occurring at a time when technological advances could enhance weather services and when the economic value of improved weather services is becoming more apparent.

Background

The National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce is the principal meteorological agency of the Federal Government, with responsibility for reporting the weather of the United States, providing weather and flood warnings and forecasts to the general public, and developing and furnishing applied weather services for specific user groups. This mission is carried out within NOAA by the National Weather Service (NWS), the National Environmental Satellite Data and Information Service (NESDIS), and the Office of Oceanic and Atmospheric Research (OAR). NWS has the principal responsibility for the plans and operations of the basic weather services and certain specific applied services. The basic mission of NWS is to help ensure the safety and welfare of the general public with respect to the effects of weather and to further the conduct of governmental and commercial activities which are affected by weather. In support of this mission, NWS observes and reports the weather and river and ocean conditions of the United States and its possessions; issues warnings and forecasts of weather, flood, and ocean conditions; and develops and operates national meteorological, hydrological, and oceanic service systems; performs applied meteorological research; assists in developing community awareness materials for weather-related natural disasters; and participates in international meteorological activities, including exchange, coding, and monitoring of data and forecasts.

New technology, currently available or on the threshold for application to meteorology, promises better weather services and products, as well as new services, through improved observations, forecasts, and communications. Technological improvements should also lead ultimately to services and products at lower cost, with reduced manpower requirements. However, introduction of new technology, such as new weather radars, computers and forecast models, display systems, and communication systems, into weather services is costly, and costs continue to rise.

Analysis

Procurement, installation, and implementation of new technology and the associated modifications to current NWS systems and operating procedures will require additional applied research and development and must be a gradual process. While there are some economies which might be achieved in the interim, perhaps through elimination of some specialized weather services now provided or through contracting out portions of NWS functions which might be accomplished more economically in that way, large personnel cutbacks, curtailment of research and development programs, and abrupt or drastic perturbations to NWS operations could result in interruption or loss of quality in services. A smooth transition to an improved NWS in the future, with accompanying cost savings then, must allow for development and testing of new equipment, training of personnel, and development and orderly introduction of new methods of operation.

The Congress might continue to look carefully at Administration proposals for retrenchment in the NWS, including budget and personnel cuts and proposed reduction in services, to determine possible effects of those proposals on current weather services and on possibilities for improvements that are offered through technological advances.

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Issue

The National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce currently operates under a large number of diverse authorities. A large portion of its programs are under permanent authorization while the remainder are authorized at various times. It has been recommended that Congress enact an organic act for NOAA, providing an agency charter as well as a single agency authorization, and that it be established as an independent agency rather than part of the Department of Commerce.

Background

NOAA was established within the Department of Commerce under Reorganization Plan No. 4 of 1970, bringing together some, but not all, of the Federal agencies and programs dealing with the atmosphere and oceans. Since its establishment, the existing complex of nearly 100 authorities under which the agency operated has been augmented as new responsibilities have been assigned to NOAA. By executive branch directive in 1980, NOAA was also assigned lead-agency responsibility for all civil remote-sensing satellite programs.

Interest in a NOAA organic act arose in Congress and the Carter Administration during the 95th Congress, and similar legislation was introduced supporting a NOAA oganic act in the 96th Congress and a so-called NOAA Improvement Act in the 97th Congress. Ever since 1969, when the Commission on Marine Science, Engineering and Resources (the "Stratton Commission") recommended the establishment of NOAA, there has been support for a NOAA which would be an independent agency. Support for such an independent NOAA was not favored by any administration until President Reagan recommended, and legislation introduced in Congress provided for, establishment of a Department of International Trade and Development, replacing the current Department of Commerce, with NOAA becoming an independent agency. No action occurred, however, on this proposed reorganization during the 98th Congress.

There also have been attempts during recent years to pass comprehensive authorization legislation covering larger segments of the agency. A series of Senate bills introduced during the 98th Congress would have provided authorizations for all of NOAA. Though more of NOAA was covered by authorization legislation than ever before in the 98th Congress, much of the agency remained under permanent authorization. One bill, authorizing appropriations for NOAA's atmospheric and satellite services (accounting for greater than half of the agency's budget) was passed by Congress, but vetoed by the President because it contained language restricting the Administration from contracting out NOAA servies.

Analysis

In recent years, the Administration has sought to reduce NOAA's budget and to contract out some services currently provided by NOAA. Congress has restored most of the proposed Administration cuts in the appropriation process and has also sought to restrict the contracting out of services through resolutions and legislation. The annual uncertainty of NOAA's budget situation, personnel restrictions, and Administration attempts to strip off NOAA programs and let contracts for services outside the Federal Government is said to have resulted in instability and low morale within NOAA, concern in other Federal agencies which depend on NOAA services, and criticism from other nations which share observations and services with the United States, through NOAA, in cooperative programs.

All of these concerns, as well as probable renewed interest in a NOAA organic act, an independent NOAA, and complete periodic authorization for much, if not all, of the agency's programs are matters with which the Congress is likely to be concerned over the next two years.

OCEAN-SENSING SATELLITES

Issue

Observations from ships, buoys, and aircraft provide sparse and spotty data from the marine environment; however, there is a continuing need for improved and extended marine observations for enhanced ocean weather forecasts; for services to marine transportation, offshore energy development, fishing, and military operations; and for understanding of oceanic processes. Though improved and extended observations are now possible through remote-sensing satellites, there is no dedicated ocean satellite currently in orbit.

Background

Meteorological satellites, in operation for over two decades, provide some capability to observe ocean characteristics; and satellite sensors have been developed specifically for measuring sea surface temperatures, ocean surface winds, wave heights, water color, and marine geodetic parameters. The first satellite dedicated to ocean observations, SEASAT, a National Aeronautics and Space Administration (NASA) research satellite, was launched into polar orbit in June 1978, but developed a short circuit and shut down permanently in October 1978. A major operational program, the National Oceanic Satellite System (NOSS), a tri-agency project of NASA, the National Oceanic and Atmospheric Administration (NOAA), and the Department of Defense, was cancelled for budgetary reasons in early 1981 after some initial studies. The Navy Remote Ocean Sensing Satellite (NROSS), a single polar-orbiting satellite, capable of measuring surface winds, sea surface temperature, and ocean surface circulation, is scheduled for launch in 1989, as the prototype of a continuing series of operational ocean satellites. While the Navy and NASA were funded in FY85 to undertake the NROSS program, NOAA did not receive funds for this purpose, and NOAA's future in NROSS is uncertain.

Other research ocean satellite programs planned by NASA include the Ocean Topography Experiment (TOPEX), to be launched in 1989, which would provide measurements of sea surface topography; the Ocean Color Imager (OCI), which would be flown on a NOAA polar meteorological satellite, beginning about 1990, to provide information on biological productivity; and the Geopotential Research Mission (GRM), a two-satellite mission which would provide, among other things, a precise measurement of the marine geoid, in 1991 or 1992. Concurrently, the European Space Agency (ESA) has also funded a satellite, the European Remote Sensing Satellite (ERS-1), which will provide ocean data and is scheduled for launch in 1988. While the United States may arrange for access to ERS-1 data, there may be some difficulty in acquiring the data, since ESA will not supply satellite data directly to military organizations like DOD, and NOAA, the other U.S. agency with capability to provide the U.S. data-receiving link, has given low priority to budgeting for this function because of the pressures for reduced funding and other needs.

Analysis

The United States has developed the technical capability for viewing the oceans from space and could realize benefits from this capability. At the same time, Japan and Western European countries recognize such potential benefits and are moving forward with development of ocean satellites. Although it is necessary to set priorities in this period of carefully controlled Federal expenditures, investment in an ocean satellite program could provide valuable economic benefits and also assure U.S. leadership in this area of technology. While it appears that some U.S. agencies (NASA and the Navy) are prepared to move forward with ocean satellite programs, budgetary constraints and low-priority within NOAA, the designated agency for civilian Earth remote-sensing satellite services, may be an obstacle to early development and operation of national ocean-sensing satellite services.

Congress could reexamine the potential opportunities afforded by a dedicated ocean satellite system as well as the importance of maintaining U.S. leadership in environmental remote sensing. In particular, the delay in providing NOAA with funding for NROSS, the potential for contracting for such data from ESA, and the generally low priority given to ocean remote-sensing services within NOAA could be examined in terms of impact on U.S. national goals in satellite remote sensing.

THE INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAM

Issue

A long-range, cooperative, interdisciplinary scientific effort to describe the subtle and complex connections that tie the geosphere and biosphere together could provide long-sought answers to the physical, chemical, and biological workings of the Sun-Earth system.

Background

The International Council of Scientific Unions (ICSU) is considering proposals for an international, interdisciplinary program to study global change in the terrestrial environment (geosphere) and the life that inhabits it (biosphere) as a closely coupled system. The system is constantly undergoing change on time scales that range from hundreds of millions of years through the slow recurrence of ice ages to transient phenomena. Changes in the geosphere that embrace the land, world ocean, atmosphere, and the solar-terrestrial domain, and in the terrestrial and oceanic biospheres, arise from the interplay of physical, chemical, and biological processes. To an increasing extent, these changes are influenced by the impact of human activity.

A central intellectual challenge of the next few decades is to broaden and strengthen understanding of the complex, subtle, and often synergistic interactions among the elements of the geosphere and biosphere. This knowledge base serves to underpin societal management of the global life support system, to enhance biological productivity, and to respond to the increasing needs of a growing population.

Analysis

Augumentation of established national and international programs would be required to illuminate the processes that govern the behavior and interactive coupling of the world ocean, atmosphere, lithosphere, cryosphere, biosphere, and the solar-terrestrial domain. This implies a bold, holistic approach which will require several years of planning and thought to develop an appropriate scientific strategy. In view of the need to pursue and support existing programs in the several elements of the geosphere and biosphere, at least three years might be allocated to formulate questions, to develop themes and subprograms, to design observational networks responsive to particular research needs, and to bring on-stream new technology. The decade of the 1990s might be considered as a target for commencement of such an International Geosphere-Biosphere Program (IGBP). In parallel with the ICSU efforts to catalyze an IGBP, a U.S. National Research Council committee has undertaken to design a set of focused initiatives for the IGBP. In effect, the committee is organizing a U.S. national plan.

While all this sounds very encouraging, the IGBP still faces some unresolved issues of a scientific, institutional, and governmental nature. Some critics in the international science bureaucracy see IGBP as a big, unwieldly umbrella program undermining existing global programs that have commenced only after years of painstaking effort. IGBP supporters acknowledge that what is needed is a limited set of high-priority, scientific thrusts around which a program of long-range scope can grow. Such a program as the IGBP might not hit its stride until the mid-1990s and might not return some of its most interesting data for 20, 40, or 50 years after that. A legitimate question, therefore, is whether and how to sustain such an effort. There is no reason why, if an efficient structure were established, it could not continue. But what kind of structure? Will it suffice to set a small advisory council to coordinate otherwise independent national efforts, as happened with the International Geophysical Year of 1957-58? Or will it be necessary to set up a new international body? Who will manage the global data archives? IGBP has not yet gained much visibility in policy circles, so it is hard to say how enthusiastic the various national governments will be. On the positive side there is an honest scientific rationale to the

program, there is potential prestige value in participating, and, in many countries, the problems an IGBP agenda might address are of practical concern. On the other hand, there is the matter of money. The cost of IGBP is still uncertain, although at this point nobody really expects to have detailed funding estimates. Critics are concerned, however, that the IGBP not come on top of existing international programs when it comes to funding priority, nor that it come at their expense. Program advocates assure the critics that IGBP will be a focus for the interaction of these existing programs and will complement them.

THE NATIONAL ADVISORY COMMITTEE ON OCEANS AND ATMOSPHERE

Issue

The National Advisory Committee on Oceans and Atmosphere (NACOA) was established to advise the Administration and the Congress on matters of oceanic and atmospheric policy. Many have praised the work of NACOA; others, however, have been critical of the Committee, claiming that it is nonessential and/or ineffective. There have been attempts within the Administration and Congress to abolish the Committee.

Background

NACOA was established initially in 1971 by P.L. 92-125, pursuant to a recommendation for such a committee by the Commission on Marine Science, Engineering and Resource (the Stratton Commission) in its 1969 report to the President and the Congress. The original 25-member NACOA was reauthorized, with some amendments, through 1977, when P.L. 92-125 was repealed and a new NACOA, with membership reduced to 18, was established by P.L. 95-63. The President appoints members, who may not be full-time employees of the Federal Government, to three-year terms on the Committee and designates the Chairman and Vice-Chairman from among those appointments. Individuals named to NACOA are required by law to be "eminently qualified" in areas of direct concern to the Committee. NACOA is also required to submit an annual report to the President and Congress and to submit other reports that may, from time to time, be requested by the President or Congress.

NACOA undertakes major studies of atmospheric and oceanic issues of national importance through panels consisting of members with particular expertise or interest, assisted by Committee staff and augmented, as required, by other experts who may brief the panel or may even become temporary panel members for part of the study. Major reports, prepared by the panels, are reviewed and finally approved by the full Committee. Major studies recently completed by NACOA or in progress by NACOA panels include: U.S. Coast Guard: Status, Problems, and Potential; The Nation's River and Flood Forecasting and Warning Service; Marine Minerals: An Alternative Mineral Supply; Nuclear Waste Management and the Use of the Sea; The Exclusive Economic Zone of the United States: Some Immediate Policy Issues; a report on the U.S. shipbuilding industry; a report on undersea technology; and a report on the North Pacific Fur Seal Treaty and its ramifications. From time to time, NACOA has also taken up shorter studies or responded to requests for advice from Federal agencies or from the Congress, before whose committees NACOA members often are asked to testify in hearings.

Analysis

There has been both praise and criticism of the expertise and work of NACOA. In spite of the increased number and adjudged quality of its published reports and despite NACOA's relatively prompt responses to short-term requests for advice, overall evaluation of the usefulness and the effectiveness of NACOA has been mixed in recent years. Opponents have criticized NACOA as being too expensive (costs have run from about $500,000 to $630,000 in recent years), as having too large a staff and too many meetings, as spending too much time on long studies and giving too little attention to problems needing quick solution, and as being relatively ineffective in shaping national policy. Supporters of NACOA, both in Congress and elsewhere, claim that the Committee has been responsive to short-term requests, has produced valuable long-term studies, has been less effective than it might be owing to a nearly annual need to "fight for its life," and has been unfairly attacked with regard to its expertise and its influence on policy.

One problem which has reduced NACOA's effectiveness has been the delay by the White House, in both the Carter and Reagan Administrations, in making appointments to Committee vacancies, some delays being well over a year. This

problem was reduced somewhat by an amendment to the December 1981 reauthorization act, which permits members whose terms have expired to remain on the Committee until replacements have been named. Although NACOA was not reauthorized by the Congress for FY85, legislation providing FY85 appropriations to the Department of Commerce included $630,000 for NACOA, so the Committee continues to operate.

During NACOA reauthorization hearings, which are likely to be conducted during 1985, there will be renewed opportunity for Congress to evaluate the quality and the effectiveness of the work of NACOA and to examine factors which have affected the efficient operation and productivity of the Committee, such as promptness in filling vacancies, adequate funding levels, consistency in reauthorizations, and the qualifications and professional expertise of those named to the Committee.